ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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What in the World!

Salvation of industry depends largely upon just how trade associations can unite their members for intelligent co-operation, it appears. That makes the question of ways and means by which the trade association may be vitalized a pertinent one. Here is one suggestion for effective price agreements —page 640.

●

With the Supreme Court backing the principle on which rate adjustments at today's costs are sought capital expenditure bases become of renewed interest.

●

New England Power Association engineers have just completed analysis of their average costs for the 13,200-kva. McIndoes 27-ft. head hydro development on the Connecticut River and find them to be $131 per kva.—page 636.

●

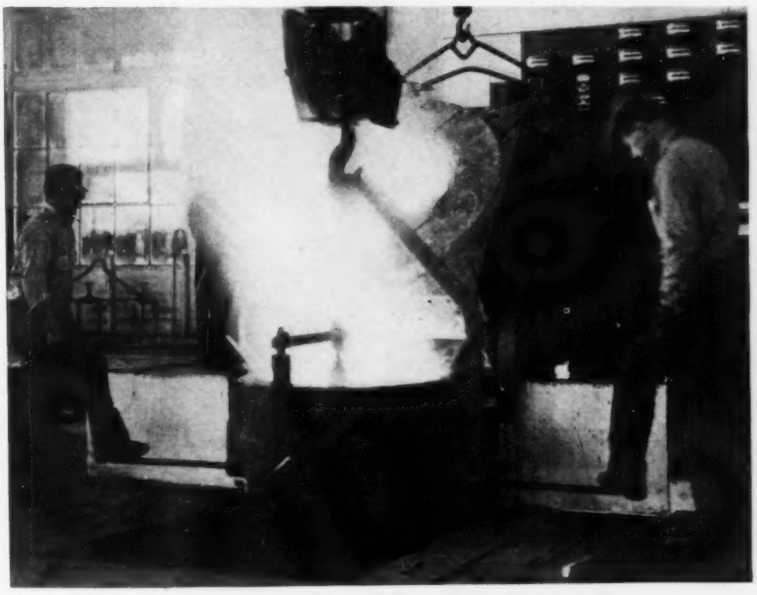
Air conditioning has been ballyhooed from the Sunny South to the Frozen North as the electrical industry's great hope and as a new market to revitalize America. Too much optimism and too few facts have done the cause more harm than good. Here are some tangibilities reported at last week's A.I.E.E. regional meeting—page 644.

●

Utilizing a new method of line regulation with equipment of the step-voltage rather than induction-type one company has cut the installed cost for line-regulating apparatus approximately in half—with considerable improvement in the results too—page 650.

●

Two conventions last week—A.I.E.E. in Schenectady, Electrochemical Society in Toronto. Both show engineers courageous and ready for future progress.



Electric steel production

MAY 20, 1933

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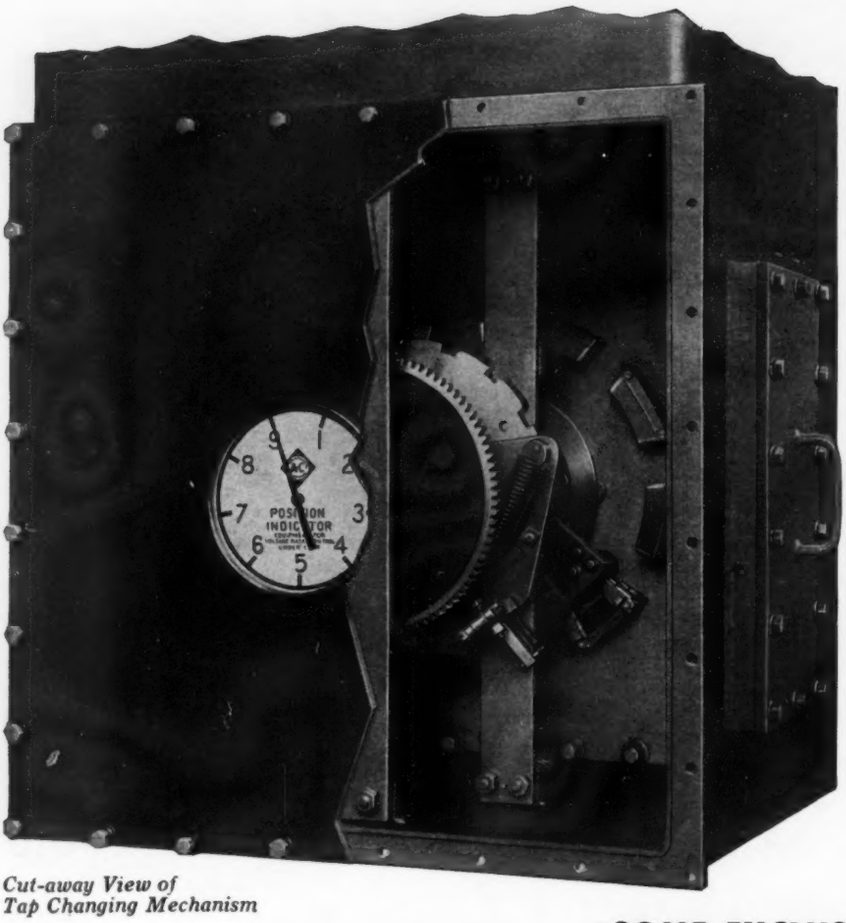
A New Automatic Feeder Regulator



Cut-away View of Tap Changing Mechanism

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◆ ◆ ◆

The new Allis-Chalmers Type AFR Automatic Feeder Regulator meets a long felt need for more economical and more efficient regulation of small capacity feeders. The Type AFR regulator can be furnished for single-phase or three-phase operation, indoor or outdoor, and for any voltage.

◆ ◆ ◆

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2. Low installation cost. Current and potential transformers are built into the unit and do not require separate mounting. There is a self-contained source of motor power. Power for the operating motor and voltage for the primary relay are obtained from an auxiliary transformer built into the equipment. The unit may be shipped in oil.
3. Low core and copper losses. Since transformers are used the losses are comparable with losses of distribution transformers of equivalent kva. parts.
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5. Quiet operation. No more noise than from a distribution transformer of equivalent rating. The tap changing mechanism is almost silent in its operation.
6. Roof-type bushings, or wiping sleeves for cable entrance.
7. Insulation co-ordinated with the bushings. . . . *Ask for Bulletin 3021.*

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ELECTRICAL WORLD

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for the Week Ending

May 20, 1933

President Offers Recovery Plan

UNDER the encompassing designation of the "National Industrial Recovery Act" President Roosevelt this week sought authority to set the wheels of commerce and manufacturing whirring at a faster rate, with consequent increases in employment and in workers' ability to spend.

This measure would not only offer the enabling legislation to permit industry co-operation and agreement heretofore denied by the anti-trust laws but would start off a $3,300,000,000 program of public works without, as the President termed it, forgetting "that it is imperative that the credit of the United States Government be protected and preserved." Mr. Roosevelt sent a special message to Congress with the proposed bill, pointing out the necessities involved.

Industry must co-operate

"My first request," he said, "is that the Congress provide for the machinery necessary for a great co-operative movement throughout all industry in order to obtain wide re-employment, to shorten the work week, to pay a decent wage for the shorter week and to prevent unfair competition and disastrous overproduction.

"Employers cannot do this singly or even in organized groups, because such action increases costs and thus permits cutthroat underselling by selfish competitors unwilling to join in such a public-spirited endeavor.

"One of the great restrictions upon such co-operative efforts up to this time has been our anti-trust laws. . . . But the public interest will be served if, with the authority and under the guidance of government, private industries are permitted to make agreements and codes insuring fair competition. However, it is necessary, if we thus limit the operation of anti-trust laws to their original purpose, to provide a rigorous licensing power in order to meet rare cases of non-cooperation and abuse. Such a safeguard is indispensable.

$3,300,000,000 of public works

"The other proposal gives the Executive full power to start a large program of direct employment. A careful survey convinces me that approximately $3,300,000,000 can be invested in useful and necessary public construction, and at the same time put the largest possible number of people to work.

"Provision should be made to permit states, counties and municipalities to undertake useful public works, subject, however, to the most effective possible means of eliminating favoritism and wasteful expenditures on unwarranted and uneconomic projects.

"Careful estimates indicate that at least $220,000,000 of additional revenue will be required to service the contemplated borrowings of the government. This will of necessity involve some form or forms of new taxation. I do not make a specific recommendation at this time, but I hope that the committee of ways and means of the House of Representatives will make a careful study of revenue plans . . . if no decision has been reached or if the means proposed do not seem to be sufficiently adequate or certain, it is my intention to transmit to the Congress my own recommendations in the matter."

If inflation actually starts it might last for some such period as six months or a year, producing a sort of cycle of false prosperity, followed by a return to severe depression. Sooner or later, I am convinced, the world will return to the gold standard, barriers to international trade will be greatly reduced, and we will settle down to some level of commodity prices which in terms of gold will not be greatly different from that which has existed during the past year. But no one can say when.

LEWIS H. HANEY,
Economist, New York University.

Professor Haney addressed the American Management Association at its annual financial management conference this week.

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Tennessee Valley Bill Submitted to President

Differences ironed out by compromise in conference, the Muscle Shoals legislation with provisions for fuller development of the whole Tennessee Valley went to the President late this week for executive approval. Both Senate and House yielded on several points.

As submitted to the President the measure retains the language of the Senate amendment with reference to the construction of transmission lines giving the power authority almost unlimited rights to construct new lines at government expense. The provision that five years' notice to private power companies be given in case of canceled contracts was retained. Contracts with municipalities and states are limited to twenty years, except that when they build their own transmission lines the contract may be for 30 years. Bond limitations of $50,000,000 were incorporated. The amended measure leaves to the discretion of the power authority how much fertilizer shall be made.

That favorite provision of Senator Norris the "profession of faith" clause was incorporated in the final bill. Five per cent of the gross proceeds from the sale of power is to go to Alabama and an equal amount to Tennessee.

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Kelvinator Enters Oil Heating

Anticipating a better distribution of effort by manufacturing and sales staffs throughout the year, Kelvinator announces its advent into the oil burner field. National coverage will not be sought until at least a year of experience with the new line has been gained.

Edison Electric Institute Announces Program for Chicago Convention

SUBJECT to minor changes and with some of the titles of the papers to be presented as yet unselected, the Edison Electric Institute program for the convention in Chicago, June 5 to 8, has been announced. In general, the sessions will be devoted to the discussion of key topics by a formal presentation and then discussion to be led by selected members. Distribution costs, service problems, promotional programs, load building in air conditioning, lighting opportunities and specific examples of what has been done by certain companies will be features of the meeting.

Monday 10 a.m. to 1 p.m.

President George B. Cortelyou presiding.

Address of the president.

Report of the treasurer.

Report of the vice-president and executive secretary.

Paper by Alex Dow, president Detroit Edison Company.

"Distribution Costs," by Norman R. Gibson, vice-president and chief engineer Buffalo, Niagara & Eastern Power Corporation.

Discussion led by P. M. Downing, vice-president Pacific Gas & Electric Company; H. W. Fuller, vice-president Byllesby Engineering & Management Corporation; H. B. Gear, assistant to vice-president Commonwealth Edison Company.

"The Fair and the Electrical Exhibit," by E. W. Lloyd, vice-president Commonwealth Edison Company.

Tuesday, 10 a.m. to 1 p.m.

"Outages, Service Standards and Investment," by S. M. Dean, chief assistant superintendent of electrical system Detroit Edison Company.

Discussion led by H. W. Eales, chief electrical engineer Byllesby Engineering & Management Corporation; B. L. Huff, Commonwealth & Southern Corporation.

"Trends and Developments in Power Stations," by F. S. Clark, consulting mechanical engineer Stone & Webster Engineering Corporation.

Discussion.

"Evaluating our National Co-ordinated Promotional Programs," by J. E. Davidson, president Nebraska Power Company.

Discussion led by P. S. Arkwright, president Georgia Power Company.

Wednesday, 10 a.m. to 1 p.m.

Meeting called to order by George B. Cortelyou, president Edison Electric Institute.

"Load-Building Opportunities in the Air-Conditioning Field," by C. E. Michel, merchandising manager Union Electric Light & Power Company.

Discussion—Industrial Applications—led by R. H. Tillman, Consolidated Gas, Electric Light & Power Company.

Discussion—Commercial and Residential Applications—led by Davis M. DeBard, Engineers Public Service Company.

Discussion by W. H. Hodge, Byllesby Engineering & Management Corporation.

"Lighting Fields to Explore for Profit," by M. E. Skinner, assistant vice-president Niagara Hudson Power Corporation.

Discussion—Commercial and Industrial Applications—led by H. M. Sawyer, American Gas & Electric Company.

Discussion—Residence and Rural Applications—led by R. E. Fisher, Pacific Gas & Electric Company.

Discussion by Oliver Hogue, Commonwealth Edison Company.

"Commercialism and Competition—Today and Tomorrow," by George E. Whitwell, vice-president in charge of sales Philadelphia Electric Company.

3:30 p.m.

Exercises on the promenade of the second floor of the Electrical Building of the Century of Progress Exposition.

Brief address by President Cortelyou.

Brief address by President Dawes.

Brief address by Mayor Kelley.

Thursday, 10 a.m. to 1 p.m.

"Taxation," by W. C. Mullendore, vice-president Southern California Edison Company Ltd.

"Trend of Rates," by F. A. Newton, Commonwealth & Southern Corporation.

Discussion led by W. J. Hagenah, Standard Gas & Electric Company.

Paper by Bernard F. Weadock, vice-president and executive secretary Edison Electric Institute.

▼

Tax and Water Control Plan Approved in California

Proposed constitutional amendments designed to control development and use of the state's water resources and to carry out the program of a joint legislative tax committee, revising the taxing system, have been approved by the California Legislature. The new tax plan is to be submitted to the people at a special election in June. Its sponsors claim that it will relieve common property of approximately $52,000,000 of taxes and will increase payments by public utilities by $4,500,000 in addition to $1,000,000 in franchise taxes.

The water-resources amendment is an enabling act to permit consummation of a state-wide water development and conservation program, including the expenditure of $160,000,000 for initial projects. This amount is to be issued in bonds if the people approve the program at the next general election.

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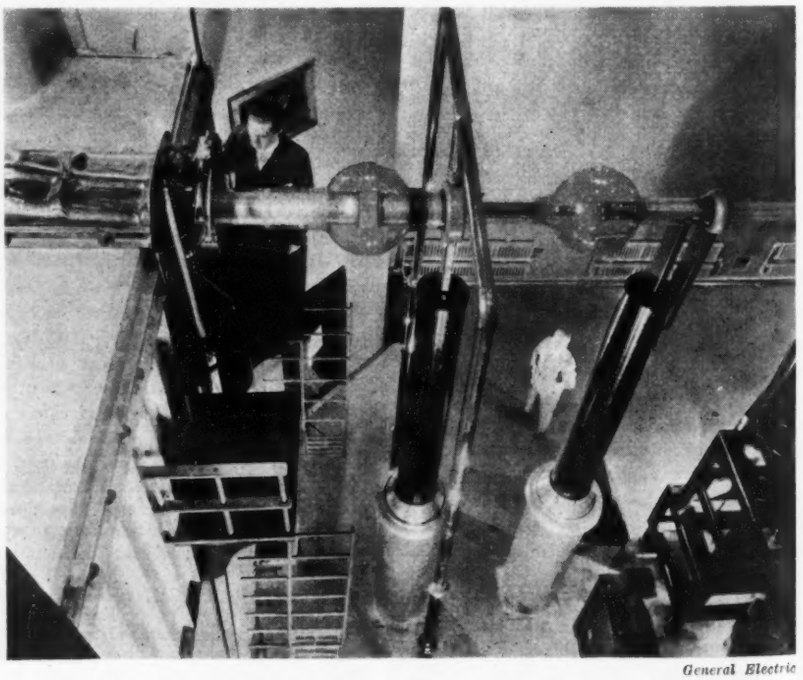
800,000 Volts to Battle Cancer



General Electric

Up and up goes the strength of the X-ray equipment used by hospitals for cancer treatment. High voltages mean faster treatments, hence less discomfort for the patient and more effective results. This apparatus in Mercy Hospital, Chicago, is rated at 800,000 volts (100,000 more than any other installation in regular operation) and 10 milli-amp. Its effect is the equivalent of $75,000,000 of radium.

California Tax Raised

Surviving a stormy career in the California Legislature, the Duval bill increasing the gross receipts tax upon utilities of that state has been signed by Governor Rolph. The tax, heretofore 7.5 per cent, will be raised by 1.5 per cent for gas and electric companies. The increase for telephone enterprises is but ¼ per cent. The measure will be effective for two years beginning July 1 providing the Riley plan for revamping the California taxation system is approved in a special election on June 27. Failure to secure approval of the electorate for the Riley plan will involve an increase in utility tax to 11 per cent.

▼

Jersey Central Control Sought for New Company

Already holding $7,500,000 of the outstanding 5 per cent debentures of the National Public Service Corporation (Insull) the E. R. Marshall committee now seeks the deposit of a total of $16,000,000 of these securities by June 15 in order to reduce to possession the collateral securing the issue and consisting largely of a two-thirds interest in the Jersey Central Power & Light Company.

As explained by the committee, "we propose to direct the trustee to sell the collateral at public auction and to agree with the trustee upon the terms of sale. We propose to bid for the Jersey Central stock a price which in our sole judgment and discretion would constitute an advantageous purchase of the property for your account.

New company planned

"We propose, if the collateral be acquired, to transfer it to a new company organized for the purpose and of which this collateral shall be the sole asset; and whose directors and officers in the first instance we shall name; which new company shall have an authorized capital stock of say 100,000 shares . . . which shall be issued in the first instance to voting trustees, who in turn will issue to you voting-trust certificates for the whole pro rata to your holdings of debentures as modified by adjustment of expenses and cost of minority interest. The voting trustees will be named by us in the first instance with appropriate provision for a control of them and of directors to be lodged in a majority of the trust certificate holders—yourselves."

Other collateral valueless

In addition to the Jersey Central stock, the collateral securing the debentures consists of all the common stock of the Seaboard Public Service Company, bankrupt, and 96 per cent of the common stock of the Municipal Service Company, holding company subsidiary of National Public Service. As there is little value in these additional securities, the committee proposes to bid for them a nominal amount over the cost of transfer.

Suit over Martin Insull bond

The receiver for the Mississippi Valley Utilites Company has entered suit against Lloyd's of London for $200,000, representing a bond covering dishonest or fraudulent acts on the part of officers and employees of the company; specific acts, involving loans of nearly $400,000 to Martin J. Insull were cited as grounds for recourse.

Turn Backward, Turn Backward, Oh Time in Thy Flight——

Little change is to be detected in the essential psychology of America in spite of the awesome lessons of the past few years. Rising under the impetus of wartime activity, from levels which once were accepted to be normal ones; drooping under the release of buying proclivity when debts had been piled up to buy cars, and radios, and bits of crackling bond paper, which today are either worn out or virtually valueless, though the debts remain; and achieving a semblance of stability at pre-war levels, America sees a return to the post-war boom as essential. Stock markets boil at the prospect. Hearts lighten at the thought.

History, if history be worth the consulting, tells that today's commodity prices are above those of half of the years in the past century and a half, measured in terms of the only permanently acceptable yardstick that mankind has so far found—gold. But men are only boys grown tall; they dream the old dreams—and continue to reject the world of reality.

Meanwhile, in the course of current events there comes a lull. No longer to be stimulated by the mere prospect of better days, markets have weakened somewhat. Car loadings fall off slightly. Energy production shoots upward, however. Automobile production flattens out its precipitous rise to wait for buying by the public to catch up with manufacturer and dealer enthusiasm. Steel at 35 per cent of productive capacity induces rising prices. General indexes show the seventh successive weekly increase. Commodity prices stand at 3.3 per cent above the corresponding week of 1932, showing a rise for the sixth successive week.

The test of artificial action draws nearer. It has not yet been applied. There is still time to accept today and reality.

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Massachusetts Referendum Sought on Smoke Abatement

So much opposition has developed in eastern Massachusetts to the curtailment of smoke abatement by legislation passed recently to do away with the division of the Department of Public Utilities having this work in hand that a referendum is being sought to determine the validity of the act (ELECTRICAL WORLD, March 25, page 372). The Secretary of State has refused to take steps toward securing a referendum on the ground that existing laws prohibit such review of statutes applying to specified restricted areas. Judge F. Delano Putnam presented a brief to the state Supreme Court this week arguing that the territory covered by the inspection service is too large and populous to fall within the narrow limits of the law cited by the Secretary of State as forbidding him to take the desired action.

Twenty-nine cities and towns, including Boston, are served, with an area of about 300 square miles and a population of 1,800,000. The benefits of smoke prevention extend to more distant communities and are not devoid of concern to the state as a whole, the brief asserted. Under the 1933 act, which was passed as an economy measure, the Utilities Department retains the duties of smoke prevention, but the work and appropriations are greatly curtailed, including the abolition of scrutiny of plans of new boiler plants and reduction of personnel.

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Energy Tax Bill Held by Conferees

WHILE early agreement in conference of Senate and House leaders was anticipated upon the shifting of the federal energy tax, no decision had been reached at the time of going to press as to what increase in taxation utilities may face.

Last week the Senate accepted the amendments to the measure proposed by its finance committee (ELECTRICAL WORLD, May 13, page 595) and the bill, previously passed by the House of Representatives for a straight transfer of levy from consumer to producer, went into conference for the adjustment of differences. The Senate favored not only the reduction of tax from 3 to 2 per cent, to be paid by the producer, and the imposition of a 1 per cent levy on industrial energy use, to be paid by the customer, but the taxation of energy generated by industrial plants in excess of 500 kw.-hr. a month and the exemption of municipally owned plants from tax liability for domestic and commercial energy use.

Coming Meetings

National Electrical Manufacturers Association—Hot Springs, Va., May 22-26. A. W. Berresford, 570 Lexington Ave., New York.

National Fire Protection Association—Milwaukee, Wis., May 29-June 1. A R. Small, 109 Leonard St., New York.

Edison Electric Institute—Chicago, Ill., June 5-8. B. F. Weadock, 420 Lexington Ave., New York.

Canadian Electrical Association — Lucerne-in-Quebec, June 14-16. B. C. Fairchild, Power Building, Montreal, Que.

American Foundrymen's Association—Chicago, Ill., June 19-24. C. E. Hoyt, 222 W. Adams St., Chicago.

American Physical Society—Chicago, Ill., June 19-24. W. L. Severinghaus, Columbia University, New York.

American Institute of Electrical Engineers—Summer convention, Chicago, Ill., June 26-30. H. H. Henline, 33 West 39th St., New York.

American Society of Mechanical Engineers—Chicago, Ill., June 26-30. C. W. Rice, 29 West 39th St., New York.

American Society for Testing Materials—Chicago, Ill., June 26-30. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

Engineers' Day. Century of Progress Exposition—Chicago, Ill., June 28. G. E. Pfisterer, 308 West Washington St., Chicago.

Illuminating Engineering Society—Delavan, Wis., August 28-31. D. W. Atwater, 29 West 39th St., New York.

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Institute Announces Program for Summer Convention

Concurrently with the Century of Progress International Exposition, the annual summer convention of the American Institute of Electrical Engineers will be held in Chicago, June 26-30. Convention headquarters will be at the Edgewater Beach Hotel. The opening session on Monday will be distinguished by the presidential address of H. P. Charlesworth, the presentation of the Lamme medal to Dr. Edward Weston and the presentation of prizes.

On TUESDAY there will be a session devoted to protective devices, including relays, circuit breakers and lightning arresters and another to instruments and measurements. In the evening there will be a meeting on industrial developments of the century, under the auspices of the American Association for the Advancement of Science, at which Dr. A. P. M. Fleming of Manchester, England, will be the principal speaker.

WEDNESDAY will be known as Engineers' Day, with a number of engineering societies participating in joint activities. Present plans call for a general assembly at the Century of Progress grounds at 10.30 a.m., where a series of short speeches will be delivered. In the evening a joint dinner will be held at the Stevens Hotel.

THURSDAY topics will include power transmission and distribution and communication and power generation. Papers read at these sessions will cover the expulsion protective gap, the Deion flashover protector and its application to transmission lines, the life of impregnated paper, accelerated aging tests on high-voltage cable and their correlation with service records, the effect of high oil pressure upon the electrical strength of cable insulation, a new method of investigating cable deterioration and its application to service aged cable, telephone carrier in cable, precision timing in the athletic and sport field, design features of the Port Washington power plant and the Beauharnois development of the Soulanges section of the St. Lawrence River. In the afternoon there will be a joint meeting with the hydraulic division of American Society of Civil Engineers and the power division of the American Society of Mechanical Engineers, at which a résumé of the engineering reports on the St. Lawrence waterway development will be presented.

Subjects to be discussed on FRIDAY include electrical machinery and welding and electrophysics and related subjects. Papers will be presented on transient torques in synchronous machines, improvements in mercury-arc rectifiers, construction features of special resistance welding machines, progress in three-circuit theory, obtaining comfort conditions by means of controlled radiation from electrically heated walls and probe measurements and potential distribution in copper a.c. arcs. The afternoon and evening will involve a joint meeting with the Econometric Society, the American Society of Mechanical Engineers and the American Society for Testing Materials, at which there will be presented "Some Fundamental Problems of Mutual Interest to Scientific Economists and Engineers."

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A.I.E.E. District Meeting in Schenectady

PROMINENT among the developments discussed at the A.I.E.E. northeastern district meeting at Schenectady last week was the thyratron as a control device. Energy supply at commercial frequency can by the aid of the thyratron be applied to a motor of the characteristic synchronous structure in such a manner as to effect speed adjustment and either the variable speed and torque performance of the series motor or the constant speed characteristic of the shunt motor. The commutator is entirely dispensed with, its functions being performed by the thyratrons. Induced draft fans and ship propulsion are applications in which it is expected that this development will show marked superiority over the manipulation of turbine speeds coupled to gener-

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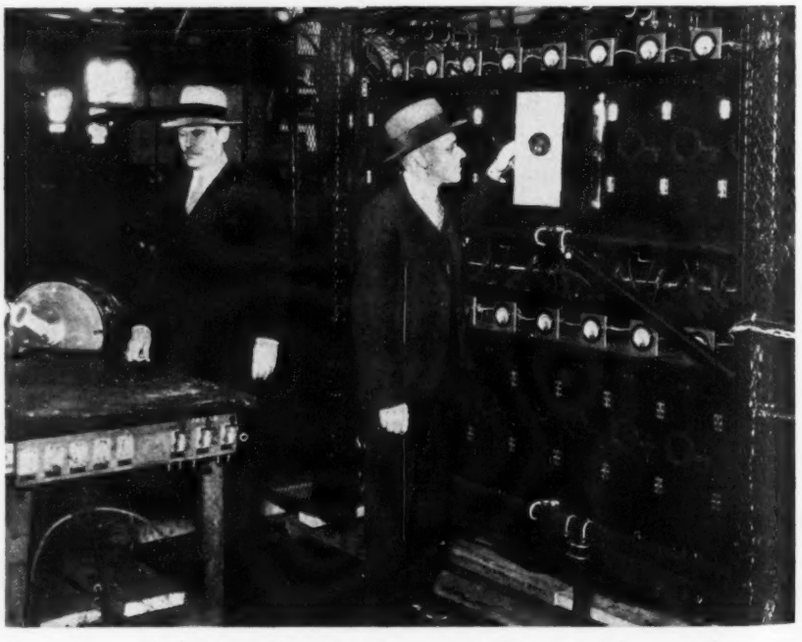
Variable Speeds With Commutatorless Motors



By means of eighteen thyratron vacuum tubes a 400-hp. synchronous motor fed directly from a 4,000-volt line gives ready variability or adjustability in speed. Described before the Northeastern district meeting of the A.I.E.E. the development was demonstrated to visitors to the General Electric Works. The tubes convert 60-cycle power to appropriate frequencies for multi-speed operation. Pilot motor at the left. Thyratron control at right. Driven motor not illustrated.

ators for supplying the adjustable speed needs of the propeller motors.

Incidental to the discussion of transformers for resistance welding it was brought out that the precise fractional-cycle control made possible by thyratrons has afforded a means of welding together such dissimilar metals as nickel, molybdenum, invar, copper and brass in both sheet and wire form. Thyratrons also provide the opportunity for balancing polyphase loading in welding installations; one instance was cited of a welding concern paying $3,000 per month rental for a special single-phase line so as to safeguard the service of other customers of the utility.

Dielectrics recorded a new generalization of the power factor, voltage, temperature, frequency characteristics of cable materials. Professors Dawes of Harvard and P. H. Humphries of Tulane showed that cable power loss varies as a constant exponential power of the voltage gradient, generally 2 at room temperature and either more or less than 2 at higher temperatures. The power-temperature characteristic for constant frequency and constant voltage gradient appears to consist of two terms, each a constant exponential function of temperature.

In a paper urging the realignment of engineering education to meet a greatly altered industry situation, Professor Karapetoff of Cornell discerned a revival of the prejudice of 50 years ago against technical training. He said the schools will have to be more like gymnasiums than restaurants if they are to provide the seekers of new ways that a versatile industry demands in place of the conventionally patterned mosaic tiles that have been produced in the recent past by too many of the engineering schools.

Air conditioning a topic

Sessions were devoted to a survey of the energy requirements for air conditioning (see pages 644-647), radio aids to aeronautics and the calorification of the concepts of reactive power and power factor under unbalanced and distorted loading conditions. Of the 425 present, nearly 200 were students from the universities in the northeastern area.

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Associated Reorganization Sought Through Debentures

Some modification of interest requirements for debentures of the Associated Gas & Electric Company, though interest is being fully earned, was foretold by J. I. Mange, president, in the annual report issued this week, "to bring immediate strength to the company in place of present weakness."

The report records progressive reductions of maturing obligations from $43,729,081 on December 31, 1931, to $9,490,805 as of May 6 last. In addition to the need for cash to meet these maturities, Mr. Mange says, "there is, of course, the need for cash to pay regular current fixed interest on the debentures. The situation is made more difficult by the fact that the banks continue to desire to be as nearly liquid as possible, and that, therefore, they refuse to make any loans except renewals or extensions of existing loans. Moreover, there is practically no bond or security market, making it impossible to raise cash in that manner. These conditions do not seem likely to improve soon; neither is it likely that the public utility business will immediately improve materially nor that collections will come in more quickly."

Subsequent to the announcement in the company's annual report, notices were mailed to holders of $265,000,000 Associated debentures of a plan for rearrangement of capitalization providing three separate methods by which the debentures may be exchanged for new securities

Three options offered

The first option offers debenture holders a new security ranking ahead of their present holdings and bearing the same rate of interest, but with a 50 per cent reduction of principal, with an option of converting the new security between 1935 and 1945 into that provided under the second option, which would restore the face amount of their obligation to its original figure.

The second option offers an equal principal amount of new securities, ranking ahead of present holdings but junior to the securities to be issued under the first option, with a reduction in interest rate ranging from one-half of 1 per cent to 1 per cent.

The third option offers a sinking fund income debenture junior to present securities but of the same face amount and interest rate, carrying with it the possibility of an increased interest return in the future.

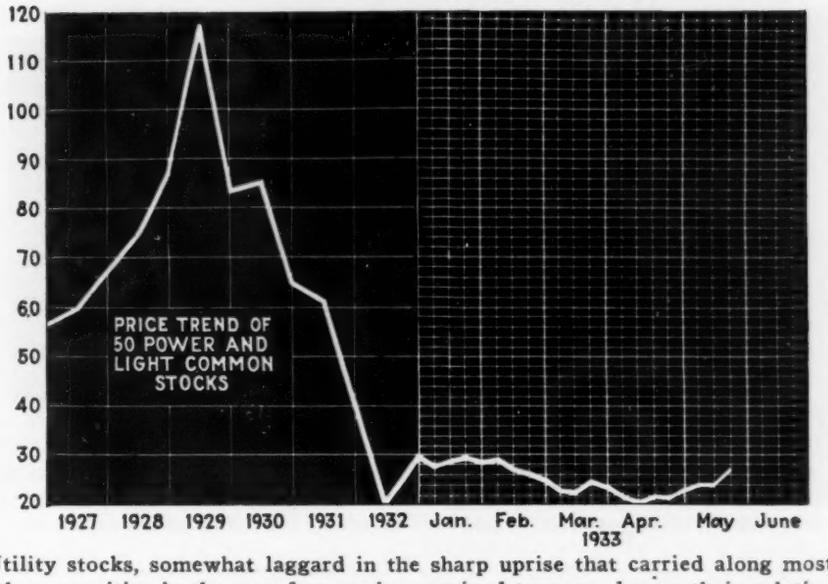
In his letter to debenture holders J. I. Mange, president, says that interest has been paid thus far notwithstanding "a substantial decline in earnings, bank holidays, slow collections, higher taxes and reductions in rates."

Earnings margin narrower

"For the twelve months ended March 31," states Mr. Mange, "the fixed interest charges of this company were $12,388,095. For the same period the consolidated net earnings were only $2,413,750 in excess of the fixed interest charges of this company. How long interest can continue to be paid depends primarily on the trend of business, freedom from additional tax burdens and rate reductions, and ability to finance future cash requirements.

"While the company may be able to meet debenture interest if general conditions do not become decidedly worse, the dangers of fixed interest securities in times like these are becoming more and more apparent. Receiverships and forced reorganizations, with all their attendant expenses, discontinuance of all interest payments and loss of operating efficiency, with delays and contests of rival committees, must necessarily follow if fixed interest charges are not met."

Utility Stocks Swing Upward



Utility stocks, somewhat laggard in the sharp uprise that carried along most other securities in the past few weeks, regained to some degree their relative position in the market this week by enough to bring the "Electrical World" average from 24.0 to 26.6

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Lead Over 1932 Increases

Climbing more than 2 per cent over the preceding week's output at a season when the trend is normally downward, electrical energy production last week increased the lead over 1932 to 2.2 per cent. According to the Edison Electric Institute central stations for electric light and power generated 1,468,035,000 kw.-hr.

Compared with the minimum, recorded in the week of March 18, this constitutes an increase of 6.8 per cent, whereas last year during the corresponding period there was a decrease of 6.6 per cent. Even in the central industrial area the previous year's operations have at last been surpassed; in New England the excess was 7.7 per cent; the Pacific Coast alone is down.

Weekly Output, Millions of Kw.-Hr.

Week ended	1933	1932	1931	1930
May 13	1,468	1,437	1,654	1,717
May 6	1,436	1,429	1,637	1,689
April 29	1,428	1,455	1,644	1,698
April 22	1,431	1,470	1,676	1,725
April 15	1,410	1,481	1,641	1,733

Per Cent Change from Previous Year

Region	Week Ended May 13	May 6	Apr. 26
Atlantic Seaboard	+4.2	+2.9	+0.5
New England alone	+7.7	+3.8	+2.5
Central industrial	+1.4	—0.2	—4.2
Pacific Coast	—7.2	—3.5	—1.3
United States	+2.2	+0.5	—1.8

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World Power Conference Completes Its Program

American participation in the sectional meeting of the World Power Conference to be held in Stockholm, Sweden, Copenhagen, Denmark and Oslo, Norway, in June and July will consist of eight papers. The International Commission on Large Dams will hold meetings at the same time and three papers will there be presented on behalf of American authors. The power conference meets June 26 in Copenhagen, June 28 and succeeding days in Stockholm and July 7 and 8 in Oslo.

Of interest to electrical engineering followers are a review of electric heating in the United States, by R. M. Cherry of General Electric; a history of electric traction developments on the New Haven Railroad, by Sidney Withington of the New Haven; a discussion of the co-ordinated production of industrial steam and utility power, by A. R. Smith of General Electric; report upon the use of electrical energy in the copper industry by Wilbur Jurden of Anaconda Copper; energy requirements of the aluminum industry, by T. J. Bostwick of the Aluminum Company, and a discussion of the interdependence of the development of a community and the utilization of electric power by Robert Sibley of the University of California.

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New York Court Rejects Commission Contract Order

Suing in equity for an injunction to restrain the New York Public Service Commission from enforcing its order of June, 1932, regarding management contracts, the New York State Gas & Electric Corporation (Associated System) last week received a decision from Supreme Court Justice F. Walter Bliss favorable to the corporation.

The order in question prohibited the companies of that group from charging into operating expenses and capital accounts payments which were being made for management and other services under long-standing contracts (ELECTRICAL WORLD, June 25, 1932, page 1077).

The court ruled that the commission lacked authority to restrain the corporation from such payments, since the contracts were entered into prior to the enactment of the state law restricting such agreements. The companies have maintained from the first that the commission was exceeding its authority and acting in violation of the constitutional rights of the utility properties.

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New Brunswick Commission Power Output Rises

That in 1932 additional loads in the district served by the Grand Lake power station increased the total power generated from 28,676,300 kw.-hr. to 37,503,222 kw.-hr. is shown in the thirteenth annual report of the New Brunswick Electric Power Commission. The high-voltage transmission line from the commission's hydro-electric plant at Musquash to St. John, thence to Moncton, is now connected at Moncton with a 66,000-volt line from the new Grand Lake steam plant to permit operating the two in parallel.

During the year the commission completed the construction of 6,600-volt lines from Devon to service the St. John Valley from Fredericton south to Oromocto and north through Kenwick and the Kingsclear district, taking in both sides of the St. John River for a distance of 20 miles north of Fredericton. The commission now has 579 miles of rural distributing lines in the province and 235 miles of high-voltage transmission line.

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Independent Offices Bill Passes House

By a vote of 249 to 118 the independent offices appropriation bill, carrying a total of $543,573,936 for the Federal Trade Commission, the Interstate Commerce Commission and other separate federal agencies, passed the House last week and was sent to the Senate. In the discussion covering the Federal Trade Commission fund Representative Beedy of Maine said that if the commission had never done anything else than to have investigated the Insull properties it would have justified its existence. Representative Oliver of Alabama said the commission's investigation of utility companies revealed escaped taxes more than sufficient to pay the expenses of the inquiry. Representative Patman of Texas declared he would like to know of one person who has paid a dollar of fine or has gone to jail an hour during the last five years because of the commission's activities.

The freedom of the commission will be somewhat restricted by a clause in the bill prohibiting it from conducting investigations at the order of a single house of Congress. Most of its inquiries have been at the instance of the Senate. Hereafter they must be ordered by a concurrent resolution of Congress.

Tax Menace to Industry Reviewed by P. H. Gossler

Approximately 69 per cent of the combined net income of the Columbia Gas & Electric system in 1932 was set aside by the management to provide for the payment of taxes, according to Philip H. Gossler in his quarterly report to stockholders.

"Taxes not only consume the incomes of individuals, but are also threatening the basic revenues from which individual incomes are derived, either as wages or return on investment," says Mr. Gossler. "This makes the problem of securing reduction in taxation one of the most pressing matters confronting this country.

Efficiency and savings penalized

"Any careful corporate management which has succeeded in maintaining stability and credit through this critical period of economic stress may be penalized for its accomplishment by taxation, both punitive and destructive, unless fairness and reason can be restored. Political attacks upon utility earnings are encouraged by their very quality of stability. On the one hand, demands are made for rate reductions; on the other, there is hardly a legislative day without its program for additional tax assessments against these properties.

"Taking the country as a whole, a reduction of 15 per cent in state and local expenditures would save the citizens an amount equal to the total cost of their domestic gas and electric service combined."

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Product Redesign Urged as Merchandising Aid

"Changed conditions make it advisable to shift the emphasis from certain types of sales appeal to others which previously have not been given sufficient consideration," R. E. Hellmund, chief engineer Westinghouse Electric & Manufacturing Company, told the manufacturing conference at the Case School of Applied Science in Cleveland last week. There are many products where serviceability, low first cost, satisfactory operating economies and reliability have been worked out to such a high degree of perfection that at this time the most promising possibilities for increasing sales appeal seem to be through greater convenience and better appearance."

Mr. Hellmund pointed out that the increasing employment of artists to guide the designing engineer in the coordinating of appearance and utility for products with an essential spirit of beauty, usefulness and sales appeal is but one trend of the times. It is the recognition that the customer will only buy that which appeals to his developed acquisitive sense and needs. Many products can and should be redesigned at once, Mr. Hellmund contended, if the market for that type of appliances and equipment is to be kept active and reasonably stimulated.

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Pinchot-King Row Waits; Philadelphia Savings Hit

Through action instituted by Attorney-General Schnader, Governor Pinchot has appealed to the Pennsylvania Supreme Court to oust Dr. Clyde L. King from the commission chairmanship to which Mr. Pinchot appointed him last year. The petition filed with the court declared that Mr. King was automatically ousted when the Senate adjourned without acting on his appointment and the Governor failed to reappoint him (ELECTRICAL WORLD, May 13, page 595). The result, the petition continues, is that Dr. King "unlawfully intrudes himself into the said office and usurps the same contrary to law." Attorney for Dr. King will file his answer to Attorney-General Schnader's petition May 22 and the case will be argued during that or the next week.

At a hearing held last week before Commissioner Gruenberg on three petitions against the new rate schedules of the Philadelphia Electric Company, emphasis was laid by protestants against the elimination of free lamps, it being claimed that this factor really made the new rates exceedingly small in potential savings to the energy consumer.

Philadelphia savings debated

Deputy Controller Wilson, on behalf of citizens of Philadelphia, Montgomery and Delaware Counties, has filed a petition stating that the company, through discontinuance of the lamp exchange privilege and the combining of light and power charges in certain classes, would reap an added profit of $2,250,000 a year in Philadelphia alone. This assertion was disputed by Frank M. Hunter, counsel for the electric company, who stated that the company's notices specified a gross annual reduction of $1,800,000 and a net reduction over these savings, through discontinuance of the lamp renewal privilege, of $800,000 to $900,000.

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Service to Receivers Must Continue

Denial of the application for review of a lower court decision in the case of a utility seeking permission to discontinue electric service to a foreclosure receiver for non-payment of service by an equity receiver has been made by the United States Supreme Court. New York Edison Company, failing to receive payment from the equity receiver for the Roxy Theatres Corporation for energy supplied, was denied the right to discontinue service to the succeeding foreclosure receiver by a lower court and carried its appeal to Washington.

Major New Construction This Week

Heavy-duty motors, controls, hoists, refrigerating machinery, conveyors, etc., will be purchased for terminal buildings of West Michigan Dock & Market Corporation, Muskegon, Mich. Cost about $1,000,000.

General electrical equipment required for beverage bottling plant of Edward & John Burke, Ltd., Long Island City, N.Y. Cost over $100,000.

Cleveland Electric Illuminating Company, Cleveland, Ohio, approves plans for large power substation at Cuyahoga Heights.

Motors, controls, hoisting equipment, etc., will be installed by Great Lakes Steel Corporation, Ecorse, Detroit, Mich., to cost $100,000.

General electrical equipment needed for Sebald brewing plant of Premier Beverage Company, Middletown, Ohio. Cost over $100,000.

General electrical equipment will be installed at Stockton, Calif., by Borden Farm Products Company, of Los Angeles. Cost about $185,000.

General electrical equipment will be installed by Manor Brewery, West New Brighton, S. I. Estimated, about $150,000.

General electrical equipment, pumping machinery, etc., will be installed by Marathon Refining Company, Fort Worth, Tex. Cost over $250,000.

Interstellar Waves Broadcast

Using an antenna rotated by motors to ascertain where in the sky certain radio waves from remote interstellar space originate, Bell Telephone Research engineers have determined upon a point 30,000 to 40,000 light years from the earth at the approximate center of gravity of our galaxy. As demonstrated over a nation-wide hook-up this week the sound was made audible by a supersensitive research set.

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Hoover Dam Renamed

Secretary of the Interior Ickes has changed the name of Hoover Dam to Boulder Dam, that by which the project was originally known. At the end of April the dam was 54.1 per cent complete. Concrete is about to be poured.

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New York Metal Prices

	May 9, 1933 Cents per Pound	May 16, 1933 Cents per Pound
Copper, electrolytic	6.75	7.00
Lead, Am. S. & R. price	3.65	3.65
Antimony	6.25	6.25
Nickel ingot	35.00	35.00
Zinc, spot	4.10	4.10
Tin, Straits	36.00	35.625
Aluminum, 99 per cent.	23.30	23.30

As to Rates——

• According to an announcement by Milo R. Maltbie, chairman of the New York Public Service Commission, the Queens Borough Gas & Electric Company will reduce immediately its electric rates to save consumers $200,000 a year. Stating that E. L. Phillips, chairman of the board of the company, and G. W. Olmstead, president, had agreed to the reduction, Mr. Maltbie said the exact rates to be put into effect to carry out the reduction would be announced in the near future.

• As a result of negotiations between representatives of the New York Public Service Commission and officials of the Long Island Lighting Company, that utility will immediately reduce electric rates in Nassau and Suffolk Counties to save consumers $500,000 a year. Commissioner Maltbie states that the lowered rates have not yet been worked out in detail.

• After conferring with other officials of the Virginia Electric & Power Company, R. J. Throckmorton, vice-president, has informed the Norfolk Public Utilities Commission "that in view of the investigation of all public utilities rates being made by the State Corporation Commission, and in view of the investigation of utility rates by the Federal Trade Commission, together with the pending legislation that would result in material increases in taxes, we cannot make any changes in our charges." In a detailed report to the City Council several weeks ago the commission recommended that immediate steps be taken to demand that the company make reductions and in a more recent report suggested that consideration be given to public ownership of electric lighting plants.

• Taking action on the petition of certain customers of the Northern Connecticut Power Company for rate reductions on electricity, gas and water service, the Connecticut Public Service Commission in a recent order upheld the company as to rates respecting gas and water service and the petitioners as to electric rates. The company has been directed to submit to the commission on or before June 15 a revision of its present schedule of rates for electric service (excepting municipal street lighting rates) that will effect in the electric department a reduction of $35,000 in the operating revenues, as estimated by the company for 1933. The revised schedule when approved by the commission shall become effective with all bills based upon regular meter readings taken on and after July 1.

• In co-operation with engineers of the Ohio Public Utilities Commission, representatives of the Ohio Edison Company will prepare an inventory to be submitted for approval to the city at the hearing of the company's appeal from an Akron electric rate ordinance. A bond of $300,000 covered by $325,000 in federal government securities will be reposted to cover the last filing of the company's appeal. The bond is to guarantee refunds to consumers if the ordinance rates are upheld by the commission.

• In a petition filed with the Indiana Public Service Commission, a group of Marion citizens has requested a reduction of at least 25 per cent in electric rates charged by the Indiana General Service Company, stating that if a reduction is not ordered the City Council would be asked to call a special election on the question of buying the utility plant.

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With the Legislators

MARYLAND—Measure passed by the recent session of the General Assembly prohibiting the assumption by any corporation, under the jurisdiction of the Public Service Commission, of any obligation or liability in respect of the securities of any other corporation, person, partnership or corporation without the authorization of the commission was signed by Governor Albert C. Ritchie. The bill also gives the commission the power to determine that such an assumption of obligation or liability is lawful and proper and consistent with the public interest.

MASSACHUSETTS—By a vote of 109 to 93 the Massachusetts House passed to engrossment the bill to permit establishment of municipal lighting plants without the purchase of existing plants. The matter must be considered by the Senate.

NEW HAMPSHIRE—House has passed a bill providing that all contracts between utilities and affiliates must be filed with the Public Service Commission, that the commission shall have access to the records of the affiliates, that excessive costs may be disallowed by the commission and that upon representation by the commission to the Supreme Court that a utility has violated terms of the act it may be placed in the hands of a receiver.

WISCONSIN—By a vote of 87 to 0 the Assembly has passed and sent to the Senate a bill giving the Public Service Commission authority to assess public utilities four-fifths of 1 per cent of their gross revenue return for any one year to pay the costs of investigating them. The present maximum which the commission may charge is one-half of 1 per cent.

Governor Park vetoes Buford bill

Listing two "good reasons" and an "additional important reason" why the measure should not become a law, Governor Park of Missouri vetoed the Buford public utility bill last week. The bill, long a moot and acrimonious question (ELECTRICAL WORLD, May 6, page 568), would have abolished the Public Service Commission, the Oil Inspection Department and the Grain and Warehouse Department and created a commerce commission to take over their functions.

"At least two good reasons," the Governor stated, "occur to me why this should not be done. The Public Service Commission is quasi-judicial. The inspection departments are purely ministerial. There is, and can be, no such relationship between the Public Service Commission and these inspection departments as to make it proper or expedient that they should be united. The other reason is that there appears to be nothing in the proposed law continuing the existence of the Public Service Commission as now established, and a serious question arises as to whether, if this bill should become a law, the time, labor and money spent in fixing valuations of public utilities by the commission would be wasted. An additional important reason is that the Legislature, now adjourned, has made no appropriation for a commerce commission. Efforts to consolidate boards and bureaus are commendable, but care should be taken not to obtain incongruous results or to destroy the fruits of labors almost, but not quite, completed."

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Cutler-Hammer Increases Wages

In presumable response to President Roosevelt's appeal to industry for increased wages, Cutler-Hammer, Inc., of Milwaukee has increased the salaries of 500 employees 5 per cent.

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Commissioner Fights Rejection

After approving Gov. E. C. Johnson's nomination of Otto Bock to the state Public Utilities Commission, Colorado's Senate later the same day reversed itself and by a vote of 20 to 15 rejected his appointment. During the interval Mr. Bock received the oath of office and contends that he should be seated. He will carry the issue to court.

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X-Ray Paper Challenges Film

As a further development in the industrial X-ray field it is announced that a paper has been produced which eliminates the costly celluloid film heretofore used and possesses notable advantages over the supplanted medium. According to the St. John X-ray Service Corporation the paper costs about half of what the film does, is easier to handle, will dry faster, needs only one intensifying screen instead of a pair, yet is just as fast as a film and will give as much contrast. The developing time is three minutes. Anything which may be examined by film may be examined with this paper.

Electrochemists Visit Canada; New Developments Discussed

Combining a strong technical program with inspection visits to various electrochemical plants, the Electrochemical Society met last week in Montreal. Papers presented varied from researches discussing photoelectric effects and the contact theory of cell action to the commercial uses of electric furnaces and electrodeposition and to the first announcement of synthetic resins made from vinyl acetate.

At the first session E. A. Ashcroft suggested the use of chloride instead of sulphate aqueous solutions for the recovery of copper ore. B. Lange introduced a new theory of the photoelectric cell by relating the infra-red wave lengths to the molecular weights of the cell material. Dr. Colin G. Fink of Columbia University suggested that great progress was being made and that it was not impossible that a very efficient cell would be developed to turn sunlight into electric power. A cyanide free bath has been developed for the deposition of copper on steel, according to Dr. Fink and C. Y. Nong. Other papers discussed chromium plating, zinc plating and electrolytic zinc. This session was followed by a round-table discussion of flotation processes, with particular reference to Canadian ores.

At the second session a new development was the discussion of rhodium plating by Dr. Fink. This process is used on airway reflectors and on jewelry and has many commercial applications as rhodium does not tarnish (ELECTRICAL WORLD, May 13, page 595). New developments in hydrogen-oxygen cells were presented and discussed. The final session was largely devoted to the electric furnace and its products. Possibly the most interesting development was the use of vinyl acetate as a by-product of carbide to make many new synthetic resins. These range from kitchenware to floor tiles and building materials and more than 175 products are available.

A visit was made to Canadian Copper Refiners, Ltd., to see modern electrolytic copper and precious metal recovery plants and an all-day trip was made to Shawinigan Falls, where the aluminum carbide, by-product and the power plants enabled interesting observations of Canada's electrochemical industries.

At the closing session Dr. Fink received the Goodrich Acheson medal for his work in the field of electrochemistry. Dr. John Johnston of Kearny, N. J., was elected president for the coming year.

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Insull to Develop Greek Coal?

Welcomed by Greece, but unable to journey elsewhere because of his canceled American passport, Samuel Insull is reported as about to embark in commercial enterprise in his country of refuge with British capital. Latest reports from Athens indicate that he is seriously investigating lignite deposits near the Yugoslavian border. He is said to plan the supply of fuel to Ægean and Black Sea ports. It is reported that he seeks Greek citizenship.

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British Engineers Investigate Transformer Noise Problem

As the result of extensive and prolonged laboratory and field tests, during which elaborate sound-measuring apparatus was sent on tour to examine many sizes, types and makes of transformers, engineers of Ferranti, Ltd., have concluded that no wholly satisfactory solution to the problem of transformer noise suppression can be accepted. As reported by E. T. Norris, chief design engineer for the organization, in a recent issue of the *Engineer* (England), the many possible sources of noise are necessarily to be attacked in a co-ordinated manner if even approximately satisfactory results are to be anticipated.

According to Mr. Norris, the main cause of noise is generated in the transformer core by vibrations of the laminations and transmitted through the oil to the tank side and then to the surrounding air. On this basis noise emission was reduced by preventing vibration of the core plates, insulating the transformer from the tanks by cushions, padding or insulating barriers in the oil, or preventing vibration of the tank sides. During some tests transformers were completely surrounded by insulating material to demonstrate the correctness of certain assumptions. Notable progress in noise suppression is said to have been effected.

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Steinmetz Relics Join Henry Ford Collection

Adding bit by bit to his extraordinary collection of historical material related to the inventive and scientific development of America, Henry Ford continues a hobby that has cost him many dollars and which will have preserved many elements otherwise forever lost to those who care to take a last salty look at the rapidly fading past.

Latest among Mr. Ford's treasures in and near Detroit is the tiny hut which long stood on the banks of a stream near Schenectady and in which C. P. Steinmetz worked out in rough notes and manuscripts many of the formulas and texts which so rapidly advanced the understanding of the electrical art under his investigation. To the bare walls of this building has been given the essential elements of historical unity through the gift by J. LeRoy Hayden, Steinmetz's foster son, of manuscripts and notes which Steinmetz prepared.

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Large British Transformer Delivered

Wide World

Modestly labeled the "Largest Transformer, 125,000 hp.," this Hackbridge Electric product was recently handled by road, water and crane to the Barking (London) power station. Weight of iron core without windings, 75 tons; with 43 miles of copper winding, complete assembly weighs 120 tons.

EDITORIALS

L.W.W.MORROW
Editor

Compulsory price agreements essential

IN THE development of any practical business plan for industry self-control we agree with W. A. Layman that price agreements are essential. His views and proposals are made as a result of a long experience in electrical manufacturing and in the electrical manufacturers' trade association and are sufficiently definite to afford a tangible program for action either to change the anti-trust laws or to work out the present administration policy of self-control under governmental supervision and authority. The happy balance sought is industry prosperity without abuse of the interests of the public or an excess of federal supervision. The trade association is the logical agency to develop the program and legalized price agreements with compulsory commitments are foundations for success.

Prices must be such that only nominal profits are made. Investments in plant and equipment must be written off rapidly under such a plan. The idea of employment insurance and old-age pensions must be translated into cost items. Costs of an enterprise doing a local business must be weighed with costs of an enterprise doing a national business. Costs of a single product manufacturer may be more or less than those of a multiple product manufacturer. Even the element of patents and royalties must be considered in fixing costs.

Any detailed basis for determining costs in order to fix fair prices is an expensive and time-consuming project, almost impossible of attainment in electrical manufacturing. The time and the money available do not permit of this procedure. It is possible, however, to get each group of manufacturers to agree upon a fair price for the several products and to enforce this price on a term basis while work is begun to establish more costs than are now available. Business is not done on an accountant's basis and never will be. A reasonable price is a matter of practical business experience and judgment and we doubt if it will ever be the sum of a series of cost figures.

Any plan for self-discipline and control of an industry can only start with a few policies and practices at this time. These definite commitments should be tried out for limited periods and must be based upon experience and judgment. Industry is groping into an unknown realm and, even if given the power to act rapidly, must proceed carefully. Positive commitments and enforcements for a few policies that can be placed in operation quickly should be the program for electrical manufacturers to follow.

New things in electrochemistry

A VISITOR to the meeting of the electrochemical society in Montreal found real inspiration in the new ideas and new things under way or in production. A suggestion based on research is that the photoelectric cell may develop into a very efficient source of power as an agency to convert the sun's energy into electricity. This new art is more than a plaything or a miniature relay; it has fundamental possibilities that are certain to be developed. Another interesting item is that processes are now commercial and economical for electroplating steel with pure copper, zinc or aluminum. What may this mean for hot water tanks, rural conductors and many other devices?

Then we find that rhodium plating does not tarnish, as does silver, and that reflectors for airports as well as jewelry both capitalize upon this new process. And again one finds that air bubbles

in cellulose acetate give a non-inflammable, tough material that should have many applications in architectural and decorative lighting to replace or supplement frosted or clear glass. But this is not the end, for starting with a carbide furnace we end with synthetic resins that make floor tile, building "glass" bricks, water pitchers and tumblers and a hundred other practical products that threaten to replace molded compounds and our usual materials. Electric steam boilers, direct reduction of iron, new products; the list of new things and the suggestions for new researches at this meeting were very large, yet some people think this is not the age of invention. No era in history promises more revolutionary changes for the future of present industries.

Attack on utilization problems should be co-ordinated

WHO can estimate what agreement on values for frequency and for utilization voltages has meant to the electrical industry and to the public it serves? Who can estimate what non-agreement on conditions of electricity service and utilization is costing the industry and the country? Both estimates, if anyone felt competent to make them, would mention very large sums of money indeed.

This is not to say that the problems of service and utilization are now being neglected. But they have been neglected in the past, and the result is that they have grown so large in terms of men and money interested as now to be extremely difficult of solution. That is, they are and will remain difficult if each one of them continues to be regarded as separate and distinct from all the rest. One committee works on wiring adequacy, another group wrestles with wiring methods and costs, another tries to blueprint services for electric ranges, and so on, without much if any co-ordination between the groups. These unrelated activities give rise to misunderstandings and to such statements as the one made recently by a utility commercial executive that utility engineers take no interest in the important problems of service and utilization.

These problems, however different in detail they may appear, have the common basis of necessity for safety and economy in the use of electricity. Until agreement has been reached by all interested parties on universally applicable rules and practices covering this basic necessity there can be little real progress toward solution of the specific problems.

Need for simplified meter installation is urgent

ALMOST every kind of apparatus in the electrical field at some time shows signs of cyclic market behavior due to accumulation of technical advances which make for accelerated obsolescence. Watt-hour meters are going through that stage at the present time. Meter progress, more or less stagnant for a decade after the first decade of induction meter evolution, has been greatly accelerated during the last seven or eight years. Along with the technical improvements has come a growing disposition to strip the meter of its individuality and give it a universality of application as a tool, a means to an end.

Terminals have been standardized, rotational speeds are more standardized, ratings have been reduced in number, load characteristics have been flattened and extended, temperature performance has been improved. More recently the new meter sequence has been authorized and affords an answer to tampering and energy diversion. But with all these there are still two definite advances needed to put metering technique where it will mean least expense in administration and maximum accuracy in energy registration. One is to simplify the installation to a means of attachment that will be most free of complexity and most immune to the something-for-nothing consumers. Another is to bring testing technique to a level of uniformity and simplicity that will permit still larger savings in over-all metering costs.

Of these the latter can wait, but a scheme of mounting as nearly as possible universal is needed imperatively right now. It would be a shame if the industry should really set out on a new program of modernized meter purchases without first giving all possible attention to agreement upon the physical manner in which the meter shall be mounted and inserted into the customer's circuit. Internal electrical improvements have predominated in the past. Now is the time to give speedy attention to the mechanics of installation and bring that to a corresponding degree of unification and progress.

McIndoes Hydro Development Built for $131 per Kva.

AN ATTRACTIVE low-head plant of 13,200-kva. rating in four units was built recently at McIndoes Falls on the Connecticut River to stabilize the flowage below the 156,000-kva. Comerford station, 7 miles above at Fifteen-Mile Falls. Comerford is a day-load plant, with a development corresponding to about 7.5 sec.ft. per square mile, and practically concentrates the river flow during the forenoon and afternoon peak demand, the head being 165 ft. The intervening river is relatively flat, so that an economic development of 5,000 c.f.s. under a gross head of 27 ft. at McIndoes was indicated, corresponding to a flow of about 2.3 sec.ft. per square mile. A comprehensive compilation of the construction costs at McIndoes has been completed by the engineering forces of the New England Power Association system and some of these data are of value from the standpoint of design estimating. The project was completed in the fall of 1931.

Development built to capacity

Readers desiring a complete description of this plant will find it in a paper* by H. E. Popp before the Boston Society of Civil Engineers. In the following paragraphs only the major features will be touched upon to add value to the cost data presented.

The development lies wholly in the townships of Monroe, N. H., and Barnet, Vt. It rests entirely on rock, and the portion damming the river consists of a concrete spillway on the east side and an integral concrete intake and power house structure on the west side, both being connected with the shores by concrete abutments. A tailrace excavated through rock conducts the water discharged from the turbines into an industrial plant pool. The drainage area is 2,200 square miles, with a pond area of 540 acres and an available pondage of 3,000 acre-ft. in a 6-ft. drawdown. Four 3,300-kva. generators, two driven by a Kaplan type automatic adjustable blade vertical turbine, generate energy at 2,400 volts and this is stepped up at the station site by a substation of 13,200 kva. rating (plus one spare 4,400-kva. transformer) to 33 kv. for transmission to Comerford.

The project required the excavation of about 28,000 cu.yd. of earth and rock, the construction and removal of 8,100 cu.yd. of cofferdam cribs and the placing of 16,300 cu.yd. of concrete. The construction plant included four steel guy derricks with 100-ft. booms, an Osgood 1.5-cu.yd. steam shovel for tailrace rock excavation, one traveling stiff-leg derrick with clamshell bucket for stripping and loading sand at an adjacent pit, a ¾-cu.yd. concrete mixing plant and a compressor plant of 1,245 cu.ft. capacity. Electricity was supplied from a 500-kva. temporary substation to all parts of the construction job. Sand was trucked to the job and gravel delivered in carload lots from West Lebanon, N. H., at $2.10 per net ton f.o.b. McIndoes.

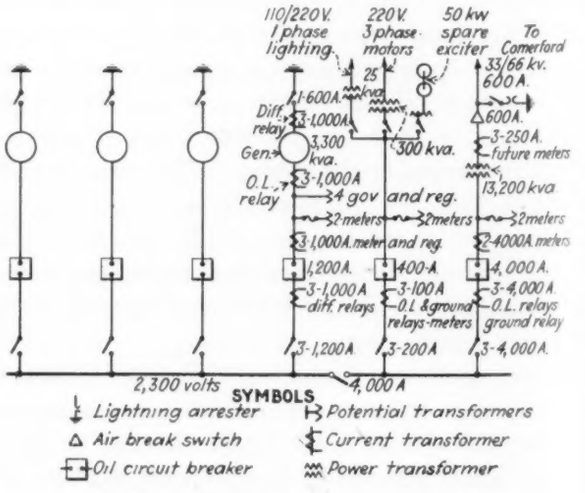
Major changes in the locality included replacing an old wooden bridge with a steel trussed bridge of 300-ft. span between abutments, highway approaches involving 8,029 cu.yd. of fill, concrete protection of a bridge abutment at Stevens Village, with the removal of 2,600 cu.yd. of rock from the riverbed to improve flow during high water; raising 2,000 ft. of Vermont state highway and 7,800 ft. of railroad, and minor work at Barnet. Although the reservoir clearing totaled but 88.9 acres, it was expensive because much of the work was on the river banks.

Spillway and Abutments—The spillway extends 520 ft.

Table I—Summarized Costs of McIndoes Development

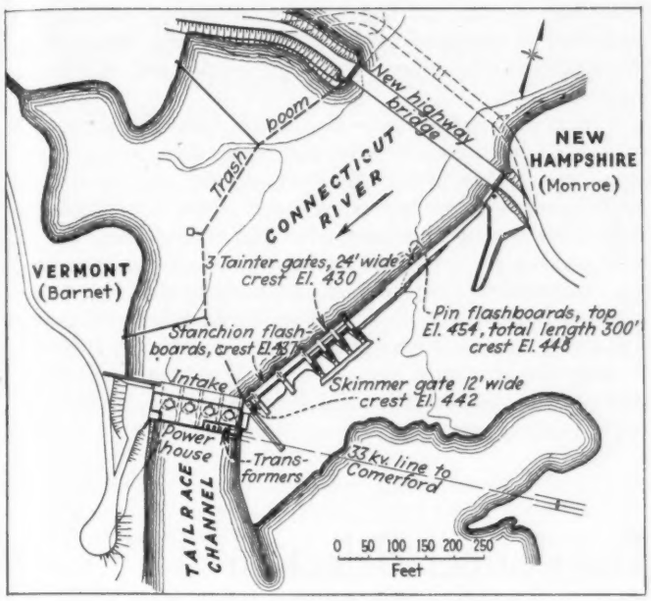
Total Rating of Plant 13,200 Kva.

		Per Kva.
1. Preliminary work	$190,714	$14.42
2. Local general expenses	163,515	12.40
3. Construction plant	106,532	8.07
4. Spillway and abutments	222,270	16.82
5. Intake and power house substructure	220,833	16.73
6. Power house superstructure	92,595	7.02
7. Hydraulic equipment	200,155	15.14
8. Indoor electrical equipment	227,498	17.20
9. Step-up substation	44,029	3.34
10. Operators' quarters (remodeling work)	2,268	0.17
11. Landscaping and power house yard	8,963	0.68
12. Tailrace	36,827	2.79
Total direct construction costs	$1,516,204	$114.78
13. Interest during construction (two years thirteen days from beginning of detail survey of riverbed to completion of project clean-up)	84,397	6.38
14. Contractor's expense	129,545	9.84
Grand total cost	$1,730,087	$131.00

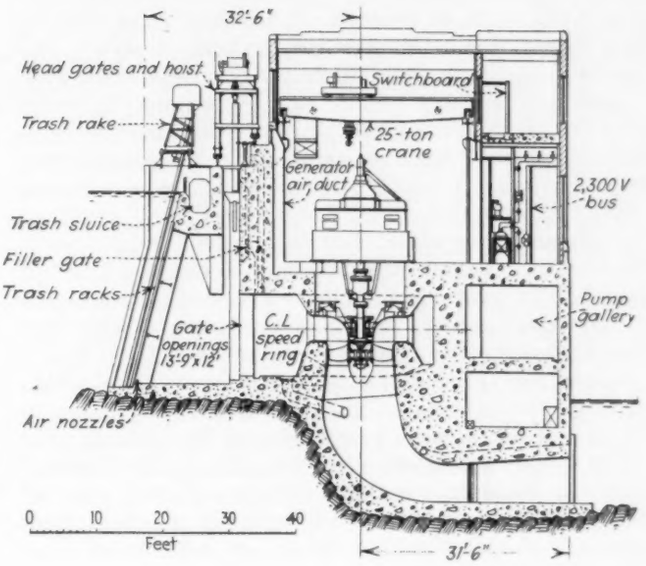


One-line diagram of main connections

Journal of the Boston Society of Civil Engineer, September, 1932.



General layout of development



Composite cross-section of plant and intake

Table II—Significant Costs from McIndoes Development

(Cents Omitted from Totals)

	Total	Per Kva.
1. Preliminary Work		
Surveys	$4,276	$0.36
Geological	691	0.05
Tailwater	2,787	0.21
Clearing pond (88.9 acres)	12,593	0.95
2. Local General Expense		
Field superintendence	19,169	1.45
Field office and storeroom	30,852	2.34
Resident engineering salaries	22,105	1.67
Camp buildings (12,856 sq.ft.)	13,945	1.08 per sq.ft.
Resident engineer's office (540 sq.ft.)	977	1.81 per sq.ft.
Fifteen months' operation camp and kitchen, 110 men housed; 140 mess. Gross $30,596. Net	4,127	0.31
Water, sewer and plumbing for camp	7,127	0.54
Insurance	18,343	1.39
3. Construction Plant		
Mixing plant, erected, including labor, $2,759	4,384	0.33
One 500-kva. temporary substation	6,888	13.77
Derricks, erecting three	22,152	1.67
Cement, 22,117 bbl.	53,435	2.42 per bbl.
Gravel, 11,977 cu.yd.	43,419	3.62 per cu.yd.
Sand, 9,318 cu.yd.	8,212	0.88 per cu.yd.
Reinforcing steel (424,015 lb.)	10,404	49.08 per ton
4. Spillway and Abutments		
Coffer dam	13,987	5.39 per cu.yd.
Spillway	100,669	7.63
Spillway channel	14,394	1.09
Pin type flashboards and sockets	3,636	2.02 per sq.ft.
Stanchion type flashboard	6,968	3.87 per sq.ft.
Flashboard handling equipment	6,982	0.53
Skimmer gate and hoist	5,638	36.14 per sq.ft.
Three tainter gates and hoists	36,671	2.78
5. Intake and Power House Substructure		
Coffer dam cribs (3,986 cu.yd.)	10,531	2.65 per cu.yd.
Coffer dam pumping	9,916	0.75
Coffer dam removal	9,031	0.68
Drilling and blasting rock excavation (5,836 cu.yd.) (3,950 lb. dynamite) including labor, $4,351	7,639	1.31 per cu.yd.
Rock excavation, disposing and loading	14,095	2.41 per cu.yd.
Total rock excavation items	22,059	3.78 per cu.yd.
Forms	35,785	0.65 per sq.ft.
Concrete (6,931 cu.yd.)	56,201	8.11 per cu.yd.
Reinforcing steel (143.6 tons)	10,174	70.86 per ton
Draft tube forms (7,816 sq.ft.)	9,056	1.16 per sq.ft.
Scroll case forms (4,100 sq.ft.)	6,552	1.60 per sq.ft.
Intake racks (27,140 sq.ft.)	6,719	0.25 per sq.ft.
Headgates and hoist	21,983	1.66
Rack take and hoist	6,230	0.47
Trash sluice gate and hoist	546	....
Trash boom (620 ft. long)	866	1.39 per ft.
Flumes for salt velocity test	4,512	....
6. Power House Superstructure		
Brickwork in place	21,393	117.87 per M.
Heating power house and brickwork	9,927	0.75
Bus structure concrete	334	....
2,300-volt bus structure	1,639	....
Structural steel	8,350	64.74 per ton
Structural steel erection	2,280	17.68 per ton
Total power house steel cost	111,112	86.14 per ton
Concrete floor slabs	11,234	25.42 per cu.yd.
Tile floors (3,381 sq.ft.)	2,292	0.68 per sq.ft.
Granolithic floors (3,787 sq.ft.)	$2,638	$0.70 per sq.ft.
Doors	2,835	....
Windows	2,028	....
Gypsteel roof (5,519 sq.ft.)	1,444	0.26 per sq.ft.
Roof waterproofing (5,519 sq.ft.)	1,669	0.30 per sq.ft.
Painting, except frame	4,964	0.38
Crane, 25 ton	7,166	287 per ton
Generator envelopes and louvers	3,575	0.28
7. Hydraulic Equipment		
Waterwheels and governors (first cost and freight) two 3,500-hp. Kaplan and two 4,750-hp. fixed blade turbines with four 42,000-ft.lb. Woodward governors	164,949	12.48
Previous item inspection and testing before shipment	303	....
Second previous item unloading and hauling to job	2,065	0.16
Third previous item cost of erection	19,284	1.46
Two air compressors installed, total motor hp. 30	2,588	0.20
Station service pumps, motors (15½ hp.)	883	....
Station service water piping	2,607	0.20
Water-metering equipment and gages	2,492	0.19
Testing, starting up and preliminary operation	4,855	0.37
Fire protection (500-gal. pressure tank)	126	....
8. Generators and Exciters		
(First cost and freight) four generators, each 3,300 kva., 2,400 volts with 55-kw. exciters, etc.	148,562	11.24
Previous item cost of hauling and erection	5,828	0.44
Spare exciter, motor-generator type 50 kv., installed	3,769	75.50 per kw.
Switchboard installed, eleven panels	19,897	1.51
Four generator and transformer circuit breakers, installed	11,465	0.87
Indoor power conduit (3,360 ft.)	1,470	....
Indoor power conductor	4,403	0.33
Control conduit (7,000 ft.)	4,784	0.36
Control conductors	2,741	0.21
Auxiliary transformers, 325 kva., installed	415	1.27
Station motor conduit and cable	6,076	0.46
Station lighting installation	4,424	0.33
Station telephone equipment	970	....
60-cell storage battery and charger	1,393	0.11
Grounds and ground wire	1,294	0.10
9. Step-up Substation		
Four 4,400-kva. transformers (first cost and freight)	36,573	2.08
Transformers, hauling and erecting	1,101	0.08
Transformer accessories, including two 2,500-gal.-tanks	2,506	0.19
One lightning arrester	974	0.07
Air break and disconnects	943	0.07
10. Operators' Quarters		
Remodeling old house in Monroe	2,268	0.17
11. Landscaping and power house yard	8,963	0.68
12. Tailrace		
Coffer dam construction (1,452 cu.yd.)	5,086	0.38
Pumping	2,166	0.16
Maintenance	154	....
Removal of coffer dam	2,208	0.17
Rock excavation (13,394 cu.yd.)	14,763	1.12
Rock loading and disposal	12,448	0.95

from the east abutment to the intake structure and contains 7,292 cu.yd. of concrete. It has three types of overflow section and a skimmer gate section—a 300-ft. section with pin-type flashboards and overhead cableway; a section with three tainter gates with motor-operated hoist; a 100-ft. section with provision for stanchion type flashboards and 2-ton monorail hoist, and a skimmer gate section with 12-ft. opening. A structural steel and concrete service bridge spans the skimmer gate, stanchion and tainter gate sections. To prevent rapid erosion downstream of the tainter gate section an apron about 118 ft. long x 19 ft. wide was provided. The west abutment is a non-overflow section. In addition to the turbine discharge, the plant will pass a total flow of 65,000 c.f.s.

Intake and Power House Substructure—The intake structure forms a part of the dam and is immediately at the west of the skimmer gate section of the spillway. The power house substructure is immediately downstream from the intake and the two form an integral mass of concrete 158 ft. long x 69 ft. wide. Foundations were carried to bedrock and 6,951 cu.yd. of concrete was placed in this structure.

The intake racks are of the inclined type, with $4\frac{1}{2}$ x $\frac{3}{8}$-in. round edge flat bars, supported by steel I-beams. The racks for each unit have an area of 659 sq.ft. A 15-ft. rack rake on a movable carriage is provided and to close intake gate openings the plant has two 12-ft. x 13 ft. 9-in. structural steel sliding headgates and a 50-ton electric hoist of the gantry type. Inlet and scroll cases are formed in the concrete without the use of steel penstocks. Draft tubes are of the elbow type, also in concrete.

Power House Superstructure—This consists of a structural steel cage inclosed in brick with reinforced concrete floors and requiring 129 tons of steel, 181,500 brick and 561 cu.yd. of concrete and aerocrete. The building has a one-story, 153-ft. x 29-ft. 7-in. x 30-ft. 4-in. generator room and a 76-ft. x 12-ft. 2-in. x 30-ft. 4-in. electrical bay. A 25-ton power house crane serves the operating room.

Electrical Equipment—Each main unit operates at 150 r.p.m. and is equipped with a 45-kw. direct-connected exciter. A spare 50-kw. compound-wound, motor-driven exciter can be put in service on any generator. The generators and transformers are connected to a single bus through individual oil circuit breakers. To carry the full load current of 3,300 amp. the main bus is of 4-in. extra heavy pipe size copper tubing. Sectionalizing disconnects are installed between the generator and transformer sections, and in order to insure energization of station service with the plant shut down the station transformers are tapped off the transformer side of the bus.

The low-tension bus structure is built of structural steel and steel panels with asbestos board phase barriers, except in the transformer bay, where brass panels are used on account of the heavy currents. Provision has been made for a future second bus. A single-phase transformer (25 kva.) serves station lighting and a 300-kva. transformer bank serves the motors on the plant auxiliaries. Station control is by 125-volt direct current governed from a remote-control switchboard above the low-tension bus structure, and there is a 60-cell storage battery.

The power transformers step up the voltage to 33 kv. Y for the present, but are built for ultimate operation at 66 kv. Since the line terminates at Comerford, only a few miles distant, no high-tension oil circuit breaker installation is required at McIndoes, but the line can be disconnected by opening a gang-operated air-break switch.

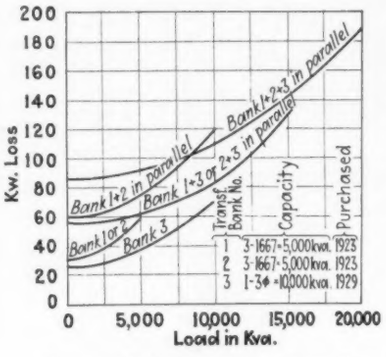
Tailrace Construction—A channel 250 ft. long was excavated from rock downstream from the plant to carry away the water from the draft tubes. In this work 13,394 cu.yd. of rock was removed in the dry behind a cofferdam having a volume of 1,452 cu.yd.

The complete cost data of McIndoes development are too voluminous for present reproduction. The summarized cost totals are shown in Table I and following that are given various significant costs entering into the summary which have been selected from the New England Power organization's compilation as of probable value to designing engineers.

▼

Transformer Selection for Loss Reduction

Selective operation of substation transformers, based on knowledge of characteristics of individual units, may repay largely the trouble taken to put it into effect by reducing system losses. Two instances of this arose in the loss reduction work now in progress on the system of the Public Service Company of Northern Illinois. In one case there were two large transformers of the same capacity which could be operated either in parallel or interchangeably. Only one of these was necessary for service at certain periods. It had been assumed that the characteristics were similar but upon investigation it was found that the newer unit had an efficiency which was 0.2 per cent higher than the other at the load carried. Operation was changed to use only the more efficient transformer at times when it would handle the load. This change brought about a saving of several thousand kilowatt-hours per month.



Lower light load loss found on larger transformer

The other case of loss reduction occurred at a substation where there were two 5,000-kva. banks of three single-phase transformers each and one 10,000-kva., three-phase transformer. It had been customary, when the load was light, to use one of the smaller banks, but upon checking the transformer characteristics it was found that the operation of the larger transformer gave better performance, even at light loads, than either of the smaller transformers on account of its relatively low losses. The accompanying curves show losses at various loads with the transformers operated in different combinations. Curves similar to these are being prepared for other substations where there is a choice of transformer operation.

More Industrial Activity in April

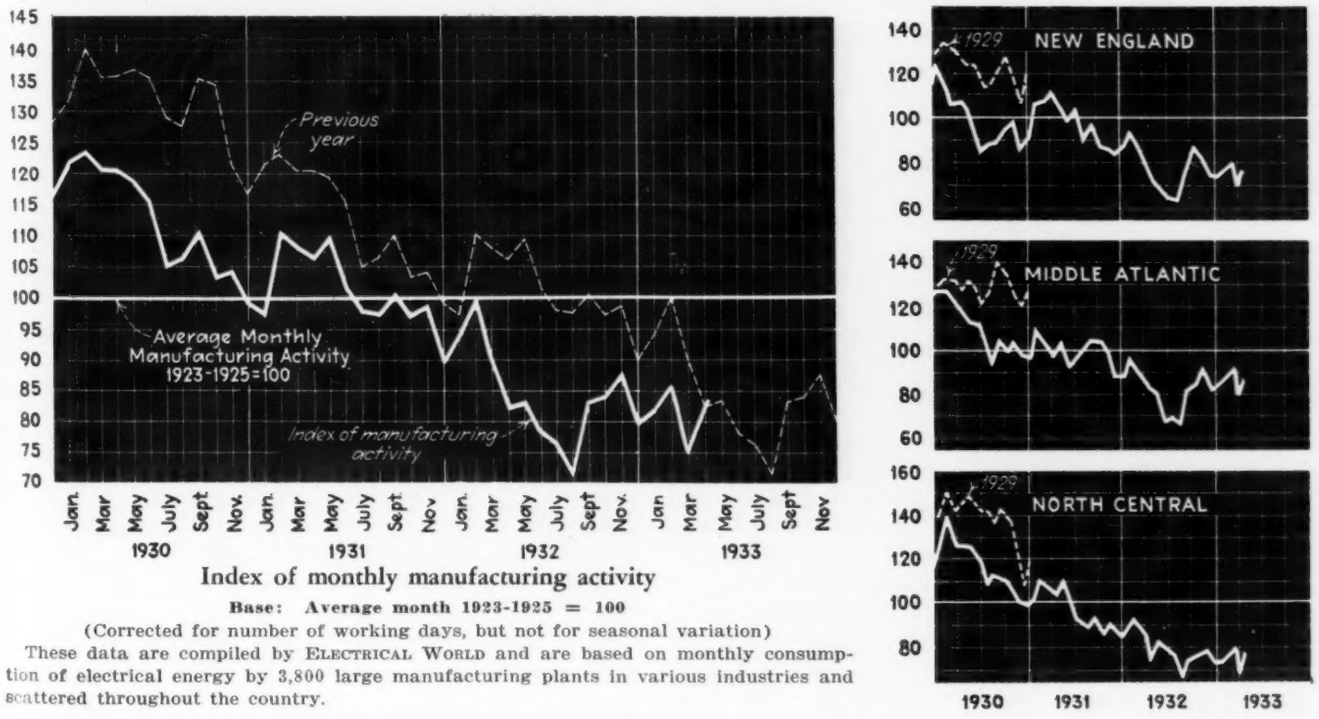
Contrasting with the record of recent years, returns of electrical energy consumption in industrial establishments received in the ELECTRICAL WORLD'S monthly survey show a marked increase in industrial activity during April compared with March. For the first time since the downward movement began, also, the weighted average is higher than that of the corresponding month in the preceding year. The gain is small—only one per cent—and the figure may be modified by the receipt of late reports, but of the improvement itself there can be little doubt.

Chemicals, leather products, forest products and textiles are well above last year's level. Foods, the metal-working industry, paper and pulp, and, at a somewhat greater distance, iron and steel are creeping up toward equality with operations a year ago.

Every industry group has a larger index number than in March for the United States as a whole, and almost without exception the same statement holds true for the several geographical regions. Moreover, the general average approaches close to that of February and a rebound, following the slackened activities attendant upon the financial disturbances of the latter month, seems clearly in evidence.

For the central and eastern industrial regions considered separately the recovery has brought up the averages so that they are as high as they were a year ago, or higher. New England textiles are holding up much better than last spring; leather also. The metals group continues level, after a slump in January. Middle Atlantic metals remain low, but make a better showing than in March. The stone group, including cement manufacture, indicates no stimulation due to new construction. Textiles and leather are much more active than a year ago.

North Central metal-working operations are better than in 1932, but far under the 1923-1925 base to which these figures are referred. The index number for automobiles indicates a pronounced increase. Reports on the number of new cars show an even larger gain than this 28 per cent over March, but it must be remembered that the present index takes account of the manufacture of parts, and not only of complete cars.


Previous year
Average Monthly Manufacturing Activity 1923-1925=100
Index of manufacturing activity
NEW ENGLAND
MIDDLE ATLANTIC
NORTH CENTRAL
1929
Jan. Mar May July Sept Nov. Jan. Mar May July Sept Nov Jan. Mar May July Sept Nov. Jan Mar May July Sept Nov
1930 1931 1932 1933

Index of monthly manufacturing activity

Base: Average month 1923-1925 = 100

(Corrected for number of working days, but not for seasonal variation)

These data are compiled by ELECTRICAL WORLD and are based on monthly consumption of electrical energy by 3,800 large manufacturing plants in various industries and scattered throughout the country.

	United States				New England				Middle Atlantic				North Central			
	Apr., 1933	Mar., 1933	Feb., 1933	Apr., 1932	Apr., 1933	Mar., 1933	Feb., 1933	Apr., 1932	Apr., 1933	Mar., 1933	Feb., 1933	Apr., 1932	Apr., 1933	Mar., 1933	Feb., 1933	Apr, 193.2
Industrial Groups																
All Industry	**83.4**	**75.3***	**85.8**	**82.2**	**74.3**	**70.2***	**79.8**	**73.2**	**86.3**	**80.8***	**91.8**	**80.7**	**77.9**	**67.8**	**80.5**	**77.2**
Automobiles (including parts and accessories)	54.3	42.6*	61.2	64.4	.....	.....	.....	.....	43.8	37.1*	63.7	61.7	55.5	41.4*	60.2	64.3
Chemical products (including oil refining)	122.7	115.6*	130.0	118.9	143.0	142.5*	138.8	152.9	128.8	121.7*	138.0	131.9	115.7	101.7*	120.7	112.3
Food products	112.8	101.5*	112.5	116.7	.....	.....	.....	.....	116.7	107.0*	111.1	85.8	106.3	96.2*	108.3	106.0
Iron and steel	59.5	50.5	64.2	64.9	81.2	82.2	83.8	91.4	46.3	40.8*	47.5	58.3	66.8	56.0	73.7	65.4
Metal working	55.3	50.5	58.4	57.2	69.2	64.2	75.7	71.6	50.7	47.2	54.1	64.4	56.8	50.1	56.5	51.2
Metals group	56.9	50.5	60.6	60.1	72.6	69.3	78.2	77.3	48.8	44.5*	51.3	61.8	60.7	52.3	60.1	57.7
Leather products	86.8	81.4*	95.0	75.6	75.0	69.7*	88.2	67.0	116.0	117.9	107.1	83.1	67.9	66.8	88.2	74.1
Forest products	93.0	84.7*	91.0	76.0	39.7	33.2*	51.8	40.1	63.2	56.3*	57.5	59.5	72.2	58.4	77.1	87.5
Paper and pulp	102.5	95.2*	111.0	105.5	95.6	90.8*	103.5	108.0	74.0	70.0*	89.9	71.0	96.8	94.0*	108.3	93.5*
Rubber products	80.0	68.0	91.0	88.3	69.1	65.2	91.7	86.0	.....	.....	.....	.....	80.2	67.7*	88.0	93.4
Shipbuilding	73.0	71.5*	89.2	91.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stone, clay and glass	71.7	68.8*	67.2	96.4	.....	.....	.....	.....	48.9	48.6*	48.4	81.3	86.7	74.7*	82.5	84.2
Textiles	86.0	79.0*	84.1	69.2	62.8	56.5	63.7	48.4	111.4	108.3*	123.0	87.8	113.3	103.6*	120.9	98.4

*Revision

Regulated Price Agreements Urged

By W. A. LAYMAN
Chicago, Ill.

Restrictive laws penalize labor and capital.

Trade associations can serve as agencies for profits.

Constructive competition should replace piracy.

IT IS not to be doubted, as L. W. W. Morrow so forcibly declared in his recent most excellent ELECTRICAL WORLD article on "Collective Action for Profits," that "business faces a crisis in management" and that "self-preservation forces trade association regulation and control . . . through which an industry group must act to protect and shield its group from external injury . . . and effect policies and practices which will bring both profits to the participants and contributions to national welfare." In his several recent articles seeking to point the way to rehabilitation of industry Mr. Morrow has made a most constructive contribution to the orderly recovery of poise and profit in business, and particularly does he strike a keynote in emphasizing the trade association as the vital medium through which balanced production and effective distribution at a profit are to be achieved. The writer indorses cordially the various practical steps Mr. Morrow proposes for promoting the effectiveness of the trade association, but, based on many years' experience in co-operative association work for business betterment, is bound to say that were *all* his suggestions carried into effect in trade association activities *the association still could not assure a profit to its membership while operating within the law.*

For forty years business has struggled to have the trade association afford a medium for reasonable self-regulation of highly competitive industry, but without practical result. The Sherman anti-trust act of 1890, as construed by the Supreme Court, has blocked every constructive effort in this direction. Even the recent Appalachian Coals decision, while indicating some recognition upon the part of the court that business suffers severely while proceeding within the law, offers partial relief to a limited group solely on the understanding that the parties in interest are but a fractional part of the industry. Any attempt to spread this decision as an avenue of relief for the industry as a whole would bring restraining action very quickly, the Supreme Court having directed retention of the case by the lower court for this very purpose, should general collective action be attempted.

In recognition of the fact that unregulated competition was defeating all the prime purposes of federal anti-trust legislation, the Federal Trade Commission attempted, several years ago, through a series of trade conferences, to relax somewhat its previous regulatory rules. New codes of ethics in competitive business were approved for a long list of trade associations. These codes did not permit price agreements, but did sanction practices which tended in that direction. Business went home from Washington feeling somewhat better. But no sooner were these new practices put into operation than the Department of Justice interposed on the ground that the codes violated the Sherman act (as they undoubtedly did). The trade commission, despite its seeming sympathy for business, had no choice but to recall the codes and put business back into the old destructive-competition status. The concentration of business into large units, the narrowing of the geographic range of small business and the steady restriction of employment opportunity for labor—all effects the anti-trust laws were supposed to prevent, but which instead have been stimulated thereby—at once took on new vigor.

Anti-trust laws unsuccessful

It has required this devastating depression to make clear to the general public that something is seriously wrong in the operation of the anti-trust laws, and for the first time since the Sherman act was passed there is a definite and growing sentiment in favor of permitting regulated, co-operative competition in business. It is most interesting to observe that labor has discovered it, too, is being penalized by these restrictive laws, heretofore supposed to keep only capital under control, and is apparently ready to join with business in advocating the legalizing of trade price agreements as the essential reform to actual preservation of that kind of competition which is in the interest of all the public.

But just here, up to the present time, business has come face to face with a real dilemma. While it believes price agreements without federal supervision will be self-regulatory in the public interest, in that excess prices will always invite new and automatic regulatory competition, it has been quite certain Congress will not permit that degree of freedom, and will insist on some kind of federal regulation against excess prices if price agreements are ever authorized. Of such regulation it has been very wary. It is prone to believe that slow death under vicious competition is preferable to political management from Washington. This fact explains why the public has not witnessed, long ago, a vigorous effort for amendment of the Sherman act to permit price agreements.

Instead, business has struggled, all these years, to build the trade association into a self-regulatory medium of constructive relief. Some actual progress has been made, after long intervals of litigation through to the Supreme Court. For example:

The trade association may engage in engineering and other forms of product standardization, so long as this does not constitute and is not equivalent to price agreement.

It may gather statistics as to magnitude of markets, stocks on hand, production capacity, etc.

It may arrive at an average cost for the industry, and supply this cost to its membership.

It may exchange price information on *previously closed* commercial transactions.

None of these activities, however, affords an assured profit upon operations. In fact, it is frequently asserted by members of such associations that this restricted information, while constituting a logical basis for intelligent price determination if it could be legally applied to that end, actually serves, in view of the legal prohibitions, to the competitive advantage of the stronger units of business. So the business man has stumbled along, relying, if he is lawabiding, upon the only open-and-above-board legal ways of circumventing the effects of unregulated competition, namely:

1. National advertising on a dominating scale, which undoubtedly lays the foundation for a widening spread between costs and selling prices, and effects a drawing away from the competitor who cannot afford equivalent advertising.
2. Producing and marketing under letters patent, which permits production monopoly and price control for the initial sale.
3. Entering into combination through financial and operating mergers until a unit strong enough to hold its own in marketing has been created.

These avenues of relief are lamentably inadequate, however, for certain difficulties arise. Many businesses have been enervated until they cannot enter successfully into competitive advertising. Controlling patents in most competitive industries have expired; licensing agreements under weak, minor patents (an expedient often attempted) are under close scrutiny of the Federal Department of Justice to prevent unwarranted price agreements by this means, and companies in weakened financial condition are unable to afford the litigation expense essential to protecting their good patents. As to mergers, this avenue also is closed to many small businesses for they have been enervated until the merger is equivalent to liquidation.

A plan needed for price agreements

What business is now looking for, in the writer's opinion, is a plan for legalizing price agreements, through the trade association, which safeguards the public against excessive prices and at the same time avoids oppressive federal regulation. Also, a plan which effects governmental regulation without expansion of operating costs for the Federal Trade Commission. The writer ventures to propose a formula for this which he believes both simple and practicable, and which safeguards both horns of the old dilemma. The proposition is an amendment to the Sherman act authorizing permissive self-regulation of business through trade associations, subject to the following limitations:

(a) That trade associations may agree upon uniform selling prices for standardized products, with correlative practices, subject to filing these agreements with the Federal Trade Commission.

(b) Coincident with the filing of selling prices the fair average production and distribution costs of the industry as a whole should be filed, these costs to be certified to the commission by public accountants who are entirely independent of but registered with the commission and operating under rules of accounting that have been approved by the commission.

(c) Costs of the individual producer and all collateral information acquired by the public accountant to be confidential with the account, and to be inaccessible to both commission and trade association.

(d) The trade commission to have authority to establish rules on unfair competition to protect, in reasonable degree, from trade piracy against such trade agreements.

In a number of respects this plan obviates objections to trade agreements as heretofore proposed. With both costs and selling prices exposed the trade association will be content with a fair and reasonable profit or it will not invoke the privileges afforded by the plan. If excessive profits are attempted, new competition will be attracted at once into the field. The privacy of the individual business is fully safeguarded. There being neither compulsion to participate nor penalty for withdrawal, the plan will be resorted to in those cases only where protection of this character is vital to the preservation of the industry. The commission will be in a position to control trade piracy when an industry as a whole has invoked its protection under the plan. It is to be noted carefully that there is preserved unrestricted competition in cost reduction between the individual members of the trade association. This constitutes strong incentive for the individual firm to make diligent effort to reduce costs and thus widen its margin of assured profit. That this premium on cost reduction be not abused against the public interest is assured by the provision for periodic revisions of average industry costs.

The plan takes into consideration that the principles of cost accounting are now well defined, that various association cost systems have been approved heretofore by the commission, and that the commission's chief responsibility will be only the licensing of reputable accountants to determine the average industry costs.

Competition is not the life of trade

Price agreements are not a cure-all for the present ills of business, but they certainly constitute a need that has become obvious alike to consumer, labor and all those free elements of business not occupying monopolistic position nor seeking one. America is the only industrial nation in the world committed to the false doctrine that free, unregulated competition irrespective of fair profit is the life of trade. Proceeding upon this theory, and with iron-clad laws believed to prevent business monopoly, we have witnessed a steady concentration of industry into dominating units, units not necessarily seeking monopoly, but having monopoly thrust upon them through the devastating gravitational influence of financial bankruptcy of the competition. The president of a large corporation remarked to the writer not long ago that he was besieged by competitors pleading to be taken over on his own terms. Bankers have scores of businesses they are seeking to merge with stronger competitive units as an escape from liquidation proceedings. In many industries uniform prices now actually prevail, to the bewilderment of the public that suspects illegal agreements, and the enjoyment of the politician accustomed to seek popular approval through baiting business. It is time for business to point out that in such instances, generally speaking, these uniform prices prevail not by agreement between competitors, but by the weaker units voluntarily falling in price line behind some strong competitor as their only chance to avoid bankruptcy. Judge Gary once publicly explained this as being within the law (though effort has repeatedly been made to have uniform prices constitute *prima facie* evidence of price agreements) by stating that the federal government could prevent agreements not to compete in price, but could not compel price competition when uniform prices were quoted without agreement. Such a method is the last legal resort of an industry faced with ruin through price competition, and before achieving self-preservation the pathway is usually strewn with industry wreckage.

There prevails today a degree of public sympathy for

constructive help to business we have not seen before. Business therefore has only to state its case frankly, and with courage, to change the whole theory of regulation from the old program of free-for-all piratical competition to one of constructive competition. The prime need is a method of assuring fair public protection without a paralyzing and expensive degree of government intervention into the business structure. Vitalizing the trade association by the method herein advocated is the writer's view of safe and sane procedure.

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Simplifying Terminal Facilities for Control Boards

By G. F. SARGENT and C. H. M. WHITE
Formerly with Stone & Webster Engineering Corporation

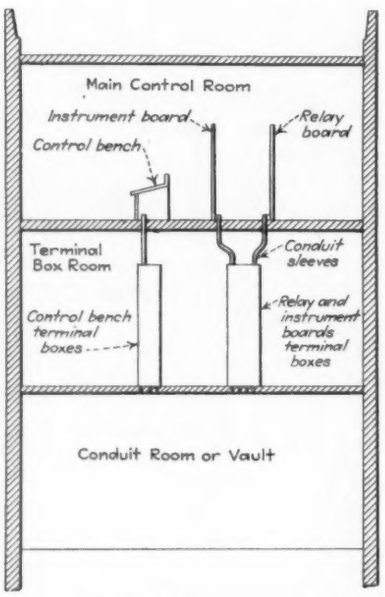
CONTINUED growth of generating plant and substation capacity has created a problem in the design of wire termination facilities at main control and instrument boards. The situation, coupled with the practice of using larger gage wire and heavier insulation, has relegated terminal blocks to the floor below the control room, where they can be placed in suitable steel boxes or cabinets. In general, switchboard panel wires are left with ends long enough to reach down to the terminal blocks in the boxes. This part of the design is nothing more than a physical relocation of the blocks.

The real problem, however, comes in the location of the many small size fuses, knife switches, instrument and transfer buses and, sometimes, resistors. Many of these must be in the same boxes as the terminal blocks, on panels or in similar boxes located in the same room with the blocks to facilitate rapid testing and maintenance. Concentration of conduits in the vault under the terminal room must be considered in order to determine whether the necessary number of present and future conduits can be run into the bottom sill plate of the box. If the layout of the station permits, some conduits can be brought into the box through the top cover plate as well as the sill plate. Therefore, it follows that the conduit entrance requirements will determine the depth of the box, whereas the height will be conditional on the number of terminal blocks and accessories that must logically be placed therein. The width will be definitely fixed by the width of the switchboard panel directly on the floor above. Since the practice is to have a box for each panel or each pair of panels back to back, such as relay and instrument panels, for the same unit of equipment, the assembly plan will be similar to the switchboard layout.

Application of these principles to a typical cross-section of a power station control bay is shown in Fig. 1.

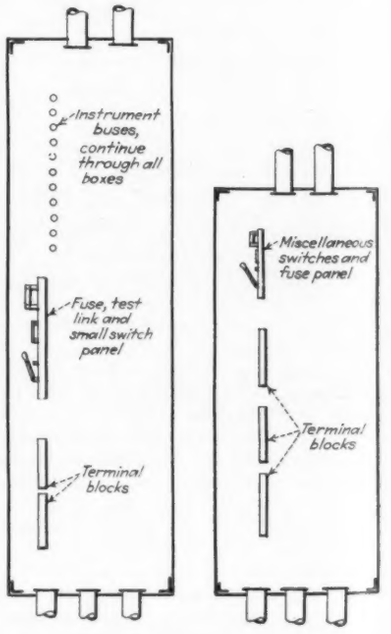
Some companies that are very insistent upon the separation of a.c. and d.c. control and instrument wires in terminal boxes accomplish this by running conduit sleeves in the correct relative number from each box to all three panels. Since the wires terminated at the control bench boxes in the average plant are 90 per cent d.c., and, similarly, the wires at the instrument and relay boxes are 90 per cent a.c., this isolation becomes very simple by the addition of the conduit sleeves just mentioned. But we are of the opinion that since the natural wiring of the circuits isolates them up to 90 per cent, as explained, it is obvious that further isolation is almost unwarranted.

As to internal design, these boxes can be roughly divided into two general classes: (1) A box similar to cross-section shown in Fig. 2, in which is included small knife switches, fuses, current and potential transformer disconnecting test links, and instrument buses, in addition to terminal blocks; (2) a box containing no instrument buses, very few test links, but terminal blocks, as shown in Fig. 3. The second type owes its simplicity to two facts—first, that small control-feed knife switches are placed on a separate d.c. distribution switchboard in the terminal room, apart from the terminal box, and, second, that the buses are eliminated by running a



The main switchboard is of the three-section type—the control bench, instrument board and relay board—the two last being placed back to back. It will be noted that one row of terminal boxes serves the bench, while the second row jointly serves the instrument and relay boards. With smaller installations the control bench is combined with the instrument board and one row of deeper boxes will replace the two rows shown.

Fig. 1—Arrangement of terminal facilities for typical control bay


Instrument buses, continue through all boxes
Fuse, test link and small switch panel
Terminal blocks
Miscellaneous switches and fuse panel
Terminal blocks

Figs. 2 and 3—Terminal boxes with and without instrument buses

few buses only in back of the switchboard panels and taking care of the remainder by looping them around in conduit jumps from box to box wherever needed. The weakness of this design lies in the last-mentioned method of running the buses. It makes too many large taps on already crowded terminal blocks, because of the large size of control wire now generally used. It is dangerous in that a man who is working in one box may disconnect the loop feed from the remaining boxes on the bus circuit.

The advantages lie in simplicity of design and complete fire isolation, since there are no holes or openings for continuous buses between adjacent boxes as in the first style of design. The first type, Fig. 2, is more self-contained, hence necessarily more complicated. The buses are right in the box with the necessary control switches and run from box to box supported on transite cleats and not in conduit. This lessens the number of conduits in the conduit vault, usually so packed that it resembles a giant bowl of spaghetti. This crowding is often so critical that the floor of the terminal box room is made of removable checker plates in order to expedite the installation of future conduits.

The authors are of the opinion that a limit has been reached on terminal box and conduit vault design, due to the severe concentration of conduits at one relatively small part of the plant. It can be cured by one of two methods: First, the decentralization of metering and control, and, second, the abolition of terminal boxes and conduit vault by the use of open cable racking and terminal racks, similar to the telephone practice of main distributing frames. The first method is so radical a departure from present general practice that it is a subject which cannot permit a discussion here, but the second method is not so radical, being more of a design than a fundamental change. The use of miniature instrument and control boards forms the backbone of the decentralization plan.

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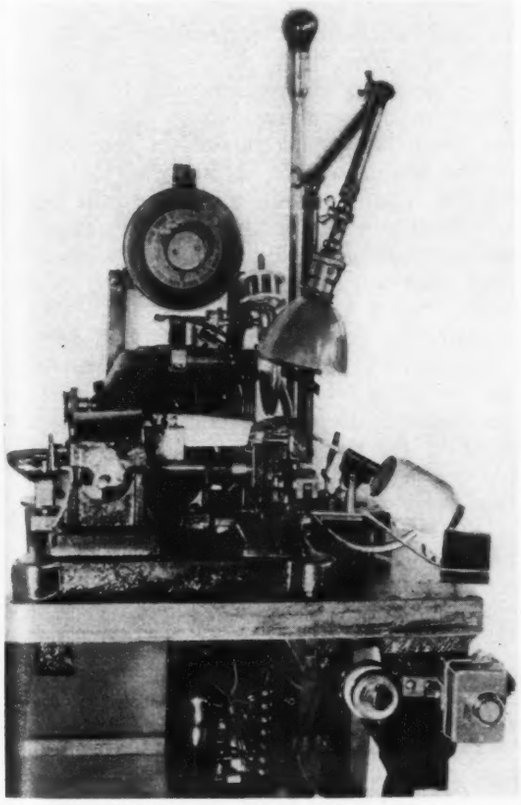
Machines Stopped Automatically by Electronic Time-Delay Relay

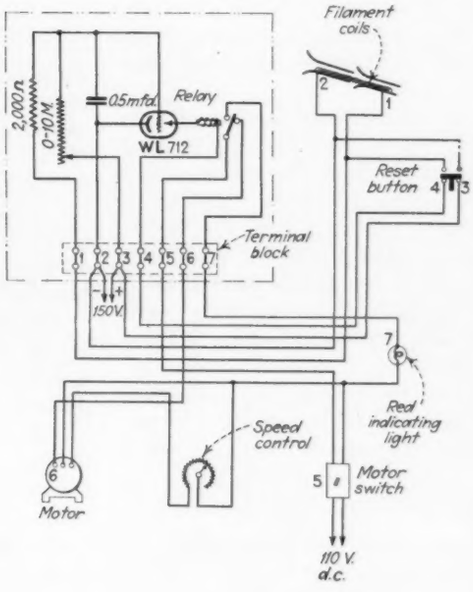
Stopping machines automatically when trouble occurs can now be accomplished inexpensively with a time-delay relay device which is actuated by a new electronic tube. It has functioned successfully on filament coil-making machines in the Westinghouse Lamp Works at Bloomfield, N. J. Heretofore the delicate construction of mandrelless coil-making machines has prohibited the use of ordinary mechanical or electrical methods of automatic stopping. As a result these machines have wasted considerable material when trouble occurred. Shrinkage has now been reduced approximately one-third and the saving effected is equivalent to the cost of installing the time-delay relays.

The new tube is the Westinghouse WL-712 filled with argon and containing two anodes and a cold cathode. The time factor is obtained by charging a condenser through an adjustable resistor. The device is economical to operate, reliable and positive in action. It is particularly suitable for application where resetting must be accomplished at high speed by electrical means and by delicate contacts. The tube itself may be used for a variety of industrial applications where a large current output must be controlled by a small input.



Delicate coil-making machine stopped by electronic relay

Operating current passes through adjustable resistor which regulates time delay period. Voltage across condenser is applied between cathode and starting anode. Upon reaching a certain value it causes the relay to trip and stop the machine. The assembly fits compactly into a metal box 6x8x4½ in. Relatively high output of the tube eliminates need of delicate relays and contacts.



New tube gives time-delay tripping with condenser charging controlled

As the filament wire is projected against a diamond die it is deflected as helical-coiled filaments resembling hair-like springs. These are cut off in lengths of a few inches at the rate of approximately 80 per minute. They pass through two funnel-shaped contacts connected in series with a 2,000-ohm resistor which is in shunt with an 0.5-mfd. condenser. Should the machine fail to produce a filament coil within the pre-set time (1½ seconds) the voltage across the condenser builds up to the critical value of the tube and trips a relay which stops the machine and lights a signal lamp.

Energy Requirements for Air Conditioning of Homes

By D. W. McLENEGAN*

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What size and type of equipment are needed to condition the air of an average home?

How long are the operating seasons for this equipment?

Must the electric utilities enlarge their service facilities to care for the added load?

Does this load combine favorably with other domestic electrical loads?

This paper presents data relating to these questions, based on climatic conditions in various parts of the country.

CONCLUSIONS derived from an extensive analysis of year-round air conditioning of homes are as follows:

1. The use of automatic heating and winter air-conditioning equipment gives rise to an electrical load which is larger, per unit, than the domestic refrigerator load and which, in general, has desirable characteristics.

2. House-cooling equipment is available in several types, with varying electrical requirements. The size of equipment required can be reduced materially if suitable house-shielding equipment is used and if the requirements for air conditioning are considered in the design of new buildings.

3. The power demand of a complete house-cooling plant is large enough to warrant the installation of a separate polyphase power supply. A plant adequate for two rooms is generally within the limits of single-phase house distribution.

4. If the operating cycle of cooling equipment adds unduly to the existing peak of domestic load it is possible to design the equipment for off-peak operation, provided savings in operating cost can be realized to offset the increased investment.

5. Without resorting to a cooling plant, a considerable improvement in summer comfort may be secured by the installation of ventilating fans, which involve a relatively small first cost and operating cost. For winter use devices to humidify and circulate the air provide similar advantages.

Functions of air conditioning

Air conditioning includes, specifically:

1. Control of air temperature.
2. Control of relative humidity, or moisture content of the air.
3. Fresh air supply and cleaning, to remove odors and dust.
4. Circulation of the air.

Although air conditioning is commonly associated with the idea of cooling in summer, it includes also heating and humidification in winter, as well as circulation of air and ventilation during all seasons. Evidence points to an improvement in health where proper equipment is installed to maintain a relative humidity of 40 to 50 per cent in winter. On the other hand, the very humid conditions which frequently prevail in summer, even when the temperature is not extremely high, call for equipment to dehumidify the air.

The advantages of clean air can hardly be questioned. A properly designed ventilating and cleaning system must not only have capacity adequate to handle several air changes per hour in the occupied room, but must also distribute this air without causing drafts. By properly directing and controlling the circulation of air we may remove the stale air.

To determine the operating requirements for air-conditioning equipment temperature charts (Fig. 1) have been prepared from the weather records of four significant cities. The heating season is taken as the period during which the monthly mean temperature is below 65 deg. For Chicago or Albany this period is approximately 9½ months, although actually about 95 per cent of the heating load normally occurs during a seven-month period.

The maximum required heating capacity is usually based on a temperature 15 deg. above the lowest ever recorded, and the plant is specified to have at least 20 per cent excess capacity, to provide quick response. The total heating effect for the season is the summation of the amounts by which the daily mean temperatures fall below 65 deg., and is obtained from the degree-day handbook of the American Gas Association. Since an automatic heating plant operating continuously at full capacity would give a degree-day product equal to the number of days by the maximum heating capacity, the number of hours' operation of such equipment is found by direct proportion (*i.e.*, the actual degree-days, divided by the maximum possible degree-days of plant output during the season). This number of hours is based on a 24-hour-per-day heating requirement.

The operating season for humidifiers has been taken as the time during which the mean outdoor temperature is below 55 deg. The total of hours is based on half-time operation over a twelve-hour day during this period.

Where forced-circulation duct systems of warm air heating are used the operating period for the fan is assumed equal to that of the heating plant, although in some systems the fan runs continuously.

For estimating the cooling season curve *B* in Fig. 1 is used, representing the monthly mean temperature plus

**Excerpts from paper presented at A.I.E.E. Northeastern District meeting at Schenectady, May 10-12, 1933*

one-half of the average daily temperature variation. Since the daily variation is approximately 16-18 deg. in summer, it is assumed that the temperature will rise 8 or 9 deg. above the mean during the daytime and fall about the same amount below the mean during the night. The limits of the cooling seasons are determined by the points where curve *B* crosses the 70-deg. line, representing a period of about four months for Chicago or Albany, five months for Washington and eight months for New Orleans. This estimate of the cooling season for Chicago and Albany may be somewhat short of the actual season, since the spring and fall months often bring periods of extremely hot weather, which are offset, in the records of monthly mean temperature, by periods cold enough to require house heating.

The maximum cooling effect which is considered desirable is shown in Table I (taken from Guide of American Society of Heating and Ventilating Engineers).

Table I—Conditions Recommended for House Cooling

Outside Temp., Deg. F.	Dry Bulb, Deg. F.	Wet Bulb, Deg. F.	Effective Temp., Deg. F.	Relative Humidity, per Cent	Grains of Moisture per Lb. Dry Air
95	80.0	65.2	73.4	45.0	69.0
90	78.0	64.5	72.2	47.5	69.0
85	76.5	64.0	71.1	50.0	69.0
80	75.0	63.5	70.2	52.5	69.0
75	73.5	63.0	69.3	56.0	69.0
70	72.0	62.5	68.2	60.0	69.0

The recommendations of Table I may be approximated if the house is cooled by one-half the difference between outdoor temperature and 70 deg.

For the Northern cities 15 deg. of cooling (with suitable control of relative humidity) generally represents the maximum size of plant which is justified, even though this may not be adequate on the occasional 100-deg. days. For the Southern cities, in which this temperature is not uncommon, a cooling capacity of 18 or even 20 deg. might be justified.

In determining the number of hours' operation of cooling equipment it may be assumed that relatively little cooling effect is needed during the night. There are, of course, exceptions in the case of unusually hot nights, and also in closely built districts where the walls of large buildings give off heat which has been stored during the day. The extent to which cooling is required during the morning is affected considerably by the night temperature, represented by curve *D* in Fig. 1 (*i.e.*, mean temperature minus half the daily variation). If the house is well ventilated during the cooler hours of the night the rise of indoor temperature may lag several hours behind the rise of outdoor temperature.

Typical equipment required

In a house of eight or nine rooms, completely air conditioned with modern apparatus, the list of equipment might include: (1) Automatic heating plant, (2) air distribution system, (3) kitchen ventilator, (4) fan type humidifier, (5) attic ventilator, and (6) refrigerating plant (5 to 6 tons†).

Alternatively, the cooling equipment might be restricted to two or three rooms, the capacity being about 2 tons. The capacity needed in these equipments is closely related to the type of building construction. For a well-insulated house, with tight doors and windows, both the winter heating and the summer cooling loads will be considerably smaller than those of an uninsulated house of loose construction. Similarly, in a loosely built house, the humidity which can be maintained may have to be held below the optimum value by the danger of condensation.

Of this equipment, the air distribution system and the kitchen ventilator would be used throughout the year and the other equipment for limited seasons, which can be estimated from the climatic data.

Within reasonable limits, the size of the heating load does not greatly affect the electrical consumption of an automatic heating plant. The rate of fuel burning is usually adjusted to the maximum heating requirement of the building, and since the rating of the electrical equipment does not increase in direct proportion to the capacity of the heating plant the energy consumption of the electrically driven mechanism is dependent principally on the severity of the weather.

On the other hand, cooling equipment of the conventional vapor compression type uses a motor-driven compressor as the means of pumping heat out of the house, hence the energy consumption is directly proportional to the total cooling load.

With electrical energy at 3 cents per kilowatt-hour a 5- to 6-ton cooling plant, requiring about 10 hp. in the compressor and auxiliary drives, involves a rather high energy cost, but by considering the sources from which

†*One ton of refrigeration is defined as the removal of heat at the rate of 12,000 B.t.u. per hour.*

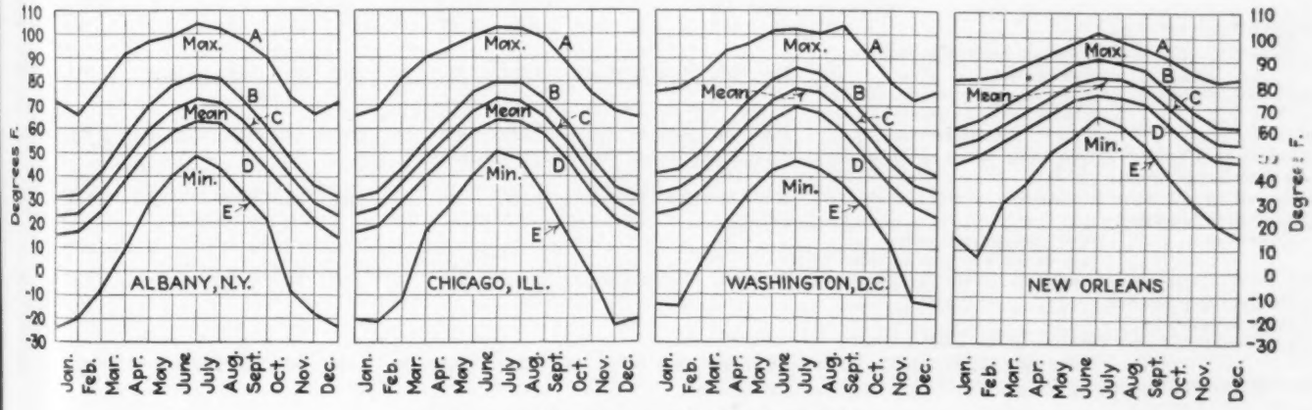


Fig. 1—Climatic records for four cities

A—Maximum ever recorded during month in 31 years. B—Mean (C) plus one-half average daily variation. C—31-year mean temperature. D—Mean (C) minus one-half average daily variation. E—Minimum ever recorded during month.

heat enters the house, we may suggest means of reducing this load and thereby bringing the equipment within the reach of a greater number of users. In a nine-room house in Schenectady the cooling load was calculated as follows:

	B.t.u. per Hour
Conduction through walls and windows	15,300
Five people (400 B.t.u. per hour per person)	2,000
Cooking — disregarded since kitchen is ventilated but not cooled.	
Lighting — negligible during the day.	
Ventilation and dehumidification	12,600
Conduction from attic, where heat accumulates from solar radiation	10,200
Solar radiation on walls and through unshaded windows	26,100
Total	66,200

This load was based on outdoor conditions of 91 deg. F. and 45 per cent relative humidity and indoor conditions of 78 deg. F. and 49 per cent, with slightly over one air change per hour.

Awnings over the windows exposed to the sun reduced the load by 11,000 B.t.u. per hour. Circulation of outdoor air through the attic, preventing the accumulation of heat due to solar radiation, further reduced the load by 10,200 B.t.u. per hour, with an expenditure of only 150 watts for the attic ventilating fan. The total cooling load was thus reduced to 45,000 B.t.u. per hour.

Use of an insulating layer in the walls would have reduced further the entrance of heat into the house, bringing the total cooling load down to about 36,000 B.t.u. per hour. A plant of this capacity would require a 5-hp. compressor motor and approximately ½ kw. of auxiliaries. Its first cost and operating cost (as well as those of the winter heating plant) would be correspondingly lower and the market considerably increased.

Use of these shielding features secures another advantage in summer, in retarding the entrance of heat by radiation and conduction. In Albany, N. Y., for example, the mean daily temperature variation during July is about 18 deg. With adequate ventilation of the house during the night the operating periods of the cooling plant during the morning are reduced by wall insulation and shielding, unless the night has been exceptionally hot. When the outdoor air cools again in the evening the heat flow through the house walls is partly reversed and a definite gain is realized from this time lag.

It is evident that the capacity and the cost of operating air-conditioning equipment are closely related to the type of house construction. When planning new buildings much may be done to reduce the size of equipment required, its operating cost and the cost of installation.

Power requirements of air-conditioning apparatus

Even among air-conditioning equipments of a single type there is a considerable variation in power requirements. Nevertheless, an average figure may be established for each important class of equipment used, to serve as a basis for estimating the energy requirements of such apparatus for the operating season. It is also possible to designate the general types of electric motors which constitute most of this load and to indicate approximately the power factor at which they operate. Summaries of this type have been prepared for Albany and Washington, D. C. (Table II). Of course, these data do not represent accurately the energy consumption for any specific make of equipment.

From these tabulations the load factor of the various devices may be estimated. As regards automatic heating equipment, in Albany the load factor is approximately 33 per cent based on eight months; in Washington 26 per cent, based on 7½ months. These values are comparable to the load factor of a domestic refrigerator, and the rate of energy use is also comparable.

The load factor of cooling equipment is somewhat lower. In Washington, for example, the operation of cooling equipment for 335 hours represents a load factor of 9.2 per cent based on an operating season of five months, or 3.8 per cent based on the whole year; for New Orleans, 17 per cent based on an eight-month operating period, or 11.4 per cent based on the year. However, all these figures are based on the operation of a single equipment and do not take account of the diversity encountered in a large number of installations. Although no operating records are available for large numbers of house-cooling installations, an indication may be obtained from Fig. 2, which shows a daily load factor of 87 per cent for 1,000 domestic refrigerators, although the load factor of a single domestic refrigerator is of the order of 30 to 40 per cent. From this we may assume that the combined load factor of a large number of house-cooling plants would also be somewhat better than that of a single plant. Furthermore, the winter air-conditioning equipment (Table II) involves a total energy use nearly as great as that of the summer air-conditioning plant, although its maximum demand is much lower. Hence, if the air-conditioning plant is considered as a whole, its load factor is materially higher than it would at first appear to be.

Fig. 3 is a typical daily load-time chart of winter air-condition-

Table II—Typical Energy Requirements for Home Air Conditioning in Two Representative Cities

Equipment	Typical Electric Load	Albany, N. Y. Motor Hp.	Watts Input	Power Factor, Per Cent	Estimated Operating Season	Total Hours	Kw.-Hr. per Season	Washington, D. C. Motor Hp.	Watts Input	Approx. Power Factor, Per Cent	Estimated Operating Season	Total Hours	Kw.-Hr. per Season
Automatic oil burner or furnace	Split-phase motor. Also controls and ignition	⅛	200	60	Sept. 15-May 15	1,880	376	⅛	200	60	Sept. 15-May 1	1,425	285
Automatic coal stoker	Split-phase motor driving stoker mechanism and blower. Control devices	⅛	250	65	Sept. 15-May 15	1,880	470	⅛	250	65	Sept. 15-May 1	1,425	356
Automatic gas furnace	The majority do not use forced draft. Hence electric energy requirement is negligible.												
Air distribution system for heating with ducts	Split-phase motor with controls.	¼	300	70	Sept. 15-May 15	1,880	564	¼	300	70	Sept. 15-May 1	1,425	428
Humidifier (with motor-driven fan)	Motor (seldom economical to use electric energy to furnish heat)	–	50	50	Oct. 1-April 15	2,160	108	–	50	50	Oct. 15-April 15	2,520	126
Cooling Equipment and Air Distribution													
(a) Two rooms (1.5 tons)	Capacitor motor used to drive compressor	3	5,000	90	May 1-Sept. 15	200	600	3½	3,500	90	April 15-Sept. 15	335	1,072
(b) Eight-room house of average construction (4 tons)	Polyphase motor generally used to drive compressor	7½	7,000	80	May 1-Sept. 15	200	1,400	9	8,500	85	April 15-Sept. 15	335	2,840
Attic ventilating fan	Split-phase motor	1/10	150	55	May 1-Sept. 15	480	72	⅛	200	60	April 15-Sept. 15	750	150

ing equipment in Albany, N. Y., and is based on the combined records of a number of installations. For comparison, a typical domestic load curve‡ is shown. The load imposed by winter air-conditioning equipment is fairly uniform throughout the day, except for a peak in the early morning, hence the installation of such equipment does not aggravate the problem of supplying on-peak load.

As regards summer air-conditioning equipment, Fig. 4 shows calculated load-time curves for a 4-ton house-cooling plant. These curves are only approximate, since their shape depends on assumed weather conditions, house construction, shielding features employed and conditions of occupancy. A typical domestic load curve‡ for summer is included. Considering residential load only, the cooling load is largely on-peak, as regards the time of day at which it occurs. From the seasonal standpoint, however, it occurs during the time of light loads, both in domestic and commercial use.

The seasonal distribution of air-conditioning load is illustrated in Fig. 5, which represents graphically the monthly energy requirements of a domestic air-conditioning plant. This chart is based on the climate of Albany, N. Y., using the data tabulated in Table II, and is generally applicable for Eastern and Midwestern cities of about the same latitude.

If the concentration of house-cooling plant loads eventually becomes a problem, it is not difficult to produce equipment with sufficient storage capacity to permit shutting down during the period of greatest domestic load. Since low temperatures are not used for comfort cooling, ice provides a suitable means of storage and the equipment can be designed to freeze ice during off-peak periods. Carrying the same idea further, the operating periods and the load factor may be increased by using equipment of small capacity and lower demand, with larger storage. During severe hot weather almost continuous day-and-night operation might be attained. However, for equipments of household and small commercial size, the addition of storage capacity involves an increase in first cost, in spite of the reduction in machine capacity. Hence, it is unlikely that house-cooling equipments with storage capacity will be widely used until the incentive of considerably lower operating cost is offered for equipments which shut down during the peak hours.

Commercially manufactured ice has been used successfully in a number of small- and medium-capacity installations where the daily and the seasonal cooling requirements are of short duration. Low initial investment is the principal advantage, since the operating cost per day is relatively high. Consideration must also be given to the space requirement, the daily attention required in refilling the ice bunkers and the removal of sediment. The question of "demand charge" may also enter, since the ice requirement is large and variable.

As an alternative to the motor-driven compressor, the water-vapor and steam-ejector cooling system justifies consideration in some cases. Given a modern automatic heating plant of the types mentioned above, steam at 12 to 15 lb. per square inch pressure may be used as the energy source. Where central plant steam is accessible the higher pressures available from this source permit a better thermal economy, which may largely offset the higher unit cost of central plant steam. The power required for auxiliary pumps and fans is relatively small, amounting to approximately ¾ kw. for an equipment of 5 tons cooling capacity. Adding to this the power required by the heating equipment, the electrical input rate becomes approximately 1 kw.

The steam-ejector cooling system cannot be applied as generally as the compression system, since it requires a larger amount of condensing water as compared with a compression refrigerating machine. But where these conditions can be met a steam-ejector system of 5 tons capacity or larger may compare favorably, both in first cost and operating cost, with a vapor compression system of equal capacity.

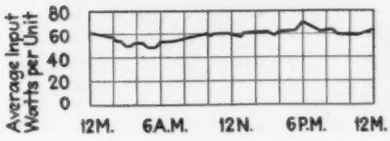


Fig. 2—Average daily load variation for 1,000 domestic refrigerators

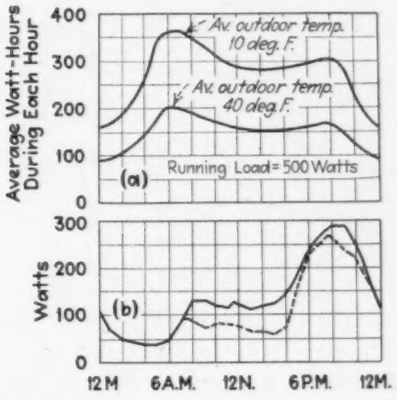


Fig. 3—Winter air conditioning doubles normal demand

(a) Heating (oil furnace), air circulation and humidifying (Albany, N. Y.)
(b) Typical domestic load, lighting and small appliances.

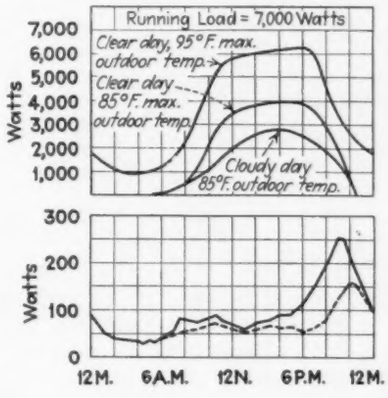


Fig. 4—Summer air conditioning increases demand twenty or thirty fold

(a) Air-conditioning load, including 4-ton cooling plant.
(b) Typical domestic load, lighting and small appliances.

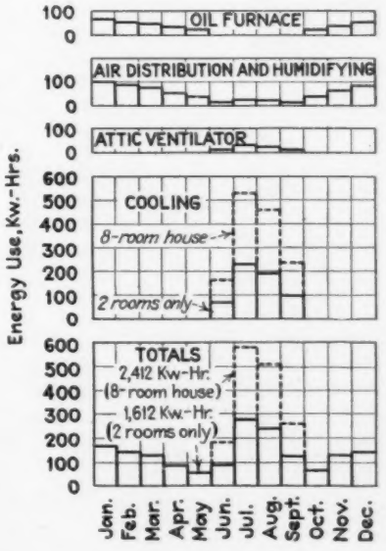


Fig. 5—Year-round conditioning gives improved load factor

‡*These curves, representing test results on a group of 400 residences, are redrawn from "Residence Load Characteristics Based on Field Studies," by G. L. Jorgensen and R. L. Matteson,* ELECTRICAL WORLD, *November 19, 1932.*

Color Lighting for the Stage

By A. L. POWELL
Manager Eastern Office
General Electric Company, Nela Park Engineering Department

Stage lighting equipment may be considered as of two types, portable and permanent or fixed. In the first group fall spotlights, floods, strips, effect machines, and the like. The second category includes the borders and foots. Colored light is secured from the first group through the use of gelatin, celophane or glass screens, interposed in the path of the light, and a wide range of color is at one's disposal. In the borders and foots colored incandescent bulbs (natural colored glass, sprayed or dipped) are widely used, although with the more recent types of instruments glass roundels or gelatin screens are employed.

If one examines specifications which are written for stage layouts he will find that it is invariably the case if three circuits are provided for the permanent lighting that red, white and blue are specified. Sometimes a fourth circuit is included and this is generally indicated as amber.

Colors poorly adapted to use

The red, white and blue combination seems by tradition to be universally accepted, yet when one stops to analyze the requirements of the stage as to color, he is impressed with the fact that these particular colors are probably as poorly adapted as any that might be chosen.

Clear or frosted lamps are used with the so-called "white" circuit and the quality of light produced by these is too harsh and severe for delicate effects. It is true that with certain types of productions, such as revues and vaudeville acts, where a particular brilliancy and punch is required, the unmodified light is desirable.

There is practically no need for red general illumination in most productions unless, perchance, there is a conflagration scene. Where red light is required it can best be supplied from portable instruments, spots and floods.

The approximately pure or deep blue light is also of little use for general lighting of the stage. True, it is, perforce, used for moonlight and night scenes, but is ill suited for this. Of course, blue flux is needed for the cyclorama, sea ground rows, and in other localized areas, but here also the desired effect is best obtained with portable apparatus, floods and strips.

Mixing two or three of these red, white and blue colors produces nothing of especial value. The red and white mixed gives a very unsaturated pink effect. The blue and white mixed gives a slightly colder light, although the blue is relatively so much less powerful than the white that it is scarcely evident even when up to full brilliancy. A mixture of the blue and red gives a pinkish purple light that exists nowhere in nature and has no logical *raison d'être*. Probably one of the most annoying and inartistic effects produced in the theater results from the practice in the motion-picture houses of flooding the curtain with this purple light, and it is even worse when the whole stage is thus illuminated. All colors are distorted and there is positively no excuse for such practice.

It is the writer's belief, based on more than two decades of observation and a considerable amount of practical personal experience, that an entirely different color combination is desirable for the general run of productions, dramatic or musical. If three circuits are used for general illumination decidedly better artistic effects can be obtained if the following colors are specified, supplied and used—light or medium straw, surprise pink or special lavender, moonlight or steel blue.

The light straw produces relatively little color modification. It has a high transmission and the quality is much softer and more delicate than that of unmodified flux. If it is used where the "white" circuit is generally employed the appearance of the set and actors will be remarkably improved.

The surprise pink color screen has the property of absorbing a narrow band in the yellow portion of the spectrum and leaves other colors more or less unmodified. It is the dominant yellow in unmodified light which makes one appear sallow and necessitates the use of heavy make-up on the stage to overcome this effect. Where surprise pink light is used very little make-up is required, faces and hands appear ruddy and healthy and the color of the scenery is not distorted.

Moonlight or steel blue is suggested for the third circuit rather than the deep blue generally used because it really gives the somewhat mystical effect of moonlight required for night scenes and does not materially distort the color of scenery or cause the make-up to appear ghastly. It can be produced more efficiently than the deep blue light and is much more practical and useful from every angle.

If a fourth circuit is provided this may be fitted with green, which is most useful in bringing out the brilliancy of foliage in exterior settings or may be used for pure red, which when mixed with the straw gives a very warm effect over the scene.

The three suggested colors are in the nature of tints rather than pure colors, and hence the total volume of light on the stage from a given wattage is relatively high. The three circuits can be mixed in varying proportions and a series of delicate gradations of tint obtained.

How to secure proper tones

The question may very properly be raised as to the method of obtaining the suggested tones. These cannot be obtained in natural glass or sprayed lamps. Vacuum type lamps can be dipped to give the desired effect. The more modern types of border and footlights, however, have the lamps inclosed in separate compartments and the light is sent through a color medium that is gelatin or glass.

Where gelatin is used, the following colors are suggested:

Circuit No. 1	No. 55 medium straw
Circuit No. 2	No. 17 special lavender
Circuit No. 3	No. 29 special steel blue or No. 41 moonlight blue
Circuit No. 4	No. 48 medium green or No. 67 fire red

To date the standard colors for glass roundels for stage equipment are red, deep amber, blue and green. As pointed out above, these are not the most desirable colors. The manufacturers of colored glass make and are ready to supply the colors suggested, provided a

demand is experienced. Using the Corning Glass Works designations, the following selections are recommended:

Circuit No. 1.....Signal amber, thin
Circuit No. 2.....Illusion pink
Circuit No. 3.....Theater blue, light shade
Circuit No. 4.....Sextant green or traffic red

Stage lighting is a field of the specialist and practical rather than theoretical considerations are dominant. The man who has had experience in lighting the more artistic type of production and has given the matter careful consideration will agree that the suggestions which have been made are logical and represent a desirable practice.

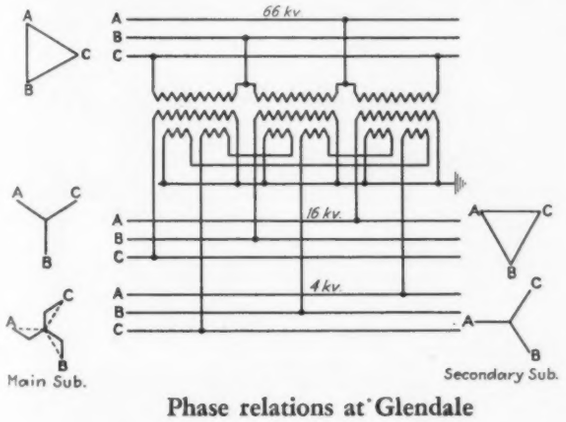
▼

Three-Winding, Zigzag Connection Saves Space

By H. L. SAMPSON
Southern California Edison Company, Ltd.

To supply the municipal system of Glendale, Calif., the Southern California Edison Company, Ltd., recently completed an interesting transformer installation. Glendale purchases power from the utility and distributes through its own system, which includes a large substation serving the business district and smaller substations serving outlying areas, all distributing at 4 kv. over four-wire grounded neutral primary systems.

In the past the central substation was supplied from the company's 66-kv. system through delta-star connected transformers, while the smaller substations were supplied from the 16.5-kv. system, also having delta-star connected transformers. Due to the fact that the Edison



Phase relations at Glendale

16.5-kv. is 30 deg. out of phase with the 66-kv., the city of Glendale was unable to parallel its 4-kv. systems.

In connection with a recently completed plan for future growth of the municipal system it was desired that the delivery of all power be made at the central substation from the Edison 66-kv. system and that the phase relation of the 16.5-kv. and 4-kv. deliveries be 30 deg. apart so that the delta-star banks in the small substations could be retained and have all 4-kv. systems in phase. It was also considered necessary to keep the 16.5-kv. in phase with the Edison 16.5-kv. system for possible emergency connection and to provide a grounded neutral on both 16.5 kv. and 4 kv.

Reliability of service demanded duplicate banks of transformers for each voltage delivered, but lack of space precluded the use of more than two banks. On this account it was decided to use two banks of three-winding units. To give the required phase relations and grounded neutrals the units were ordered with 66-kv. delta primary and with 16.5-kv. star and 4-kv. zigzag secondaries.

The primary windings have a total capacity of 5,000 kva., with each secondary winding having a capacity of 3,000 kva. to take care of variations in demand. Both banks are provided with the usual overload and differential relay protection and the output is metered through four wattmeters and a four-element totalizing demand meter. The accompanying diagram shows the connection used and the phase relations of the various secondary voltages. Savings in first cost, losses and floor space are features of the installation.

▼

New Hampshire's Rural Yardstick $1,281 per Mile

To reach an average cost of single-phase, 2,300-volt joint rural line construction the New Hampshire Rural Electrification Committee recently tabulated the following data to aid utilities and agricultural interests in the Granite State in studying the outlays required for this class of service. The data were checked by virtually all the power companies in the state, as well as the telephone company, with regard to allowance for joint use. Four customers per mile were assumed.

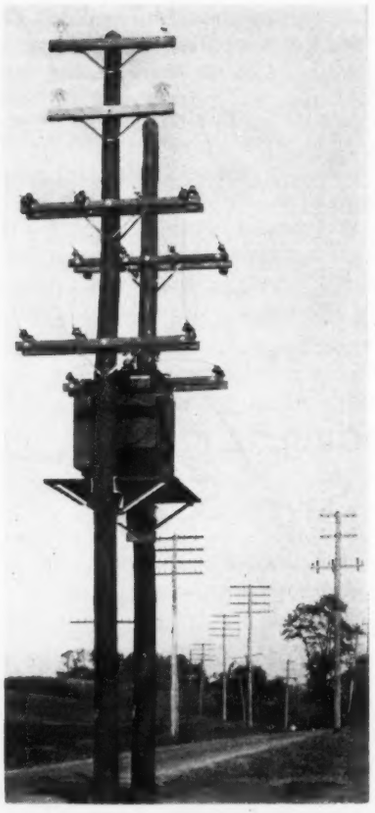
Material	Unit	Quantity	Unit* Cost	Amount
Primary Line				
Poles				
30-ft. poles class B, pine, full-length treatment	ea	30	$10.20	$306.00
35-ft. poles class B, pine, full-length treatment	ea.	10	14.50	145.00
Labor setting poles	ea.	40	5.50	220.00
Crossarms (complete with hardware and through bolts)				
2 pin crossarms	ea.	46	0.98	45.08
Labor installing crossarms	ea.	46	0.38	17.48
Insulators				
No. 44 insulators, pin-type, porcelain	ea.	92	0.07	6.44
Wire				
No. 6 wire T.B.W.P. medium hard drawn copper	lb.	1,180	0.15	177.00
Labor installing wire	.....	.....	.....	75.00
Guys (complete and installed)	ea.	15	6.76	101.40
Tree trimming	.....	.....	.....	55.00
Transportation	.....	.....	.....	75.00
Sub-total				$1,223.40
Secondaries and Services				
Racks or crossarms				
3 spool racks installed complete	ea.	7	1.65	11.55
Secondary wire				
No. 6 W.P.T.B. medium-hard drawn copper wire	lb.	180	0.15	27.00
Labor installing secondary wire	.....	.....	.....	20.00
Services installed	2 wire	2	8.00	16.00
Services installed	3 wire	2	12.00	24.00
Transportation	.....	.....	.....	10.00
Sub-total				108.55
Transformers and Meters				
Transformers installed (complete with cutouts, arresters and grounds)	5 kva.	1	100.00	100.00
	3 kva.	1	85.00	85.00
	1½ kva.	1	70.00	70.00
Meters installed	each	4	10.00	40.00
Sub-total				295.00
Sub-total				$1,626.95
Contingency 10 per cent				162.69
Grand total				$1,789.64
Credit on account of joint line use				508.70
				$1,280.94

Monthly guarantee for five years 21.35 ÷ 4 = 5.34
*Unit costs as of June 1, 1932.

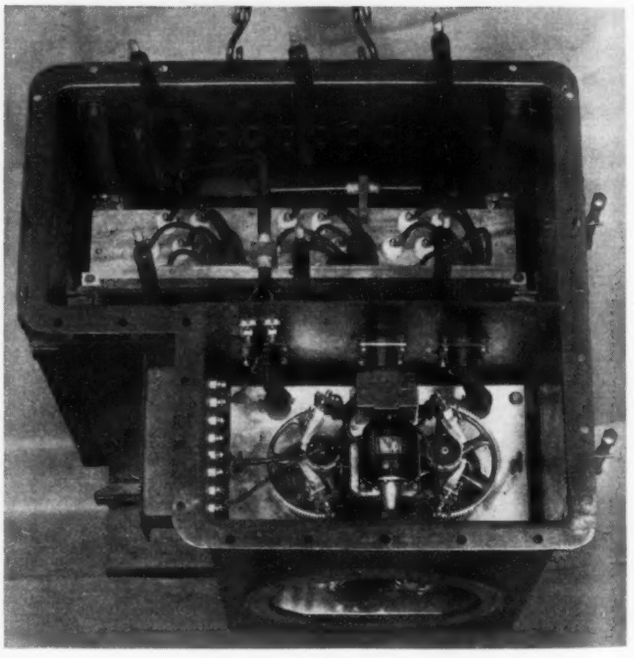
First Step-Regulator Installation

- Applied to rural lines.
- Gives automatic 10 per cent boost and buck in 2½ per cent steps.
- Installed cost for 1,080-kva. unit $3,250.
- Operation very satisfactory and installation inexpensive.

By T. F. HILDEBRAND
American Gas & Electric Company, New York



Automatic step-regulator installation on Roanoke-Fincastle line of Appalachian Electric Power Company



Top view of step-regulator with cover removed

THE maintaining of good voltage values and regulation on rural lines often offers a problem which is hard to solve due to the economic factors involved. The low-load density and relative low revenue per mile of line necessitate that the investment in lines and equipment be held down to a corresponding low figure. This, in short, means that an elaborate system of high-voltage transmission lines and step-down substations to serve rural areas cannot be economically justified and that the lines to serve such loads must be extended many miles out from existing distribution sources, or from new, inexpensive substations sparsely but strategically located with respect to both load to be served and existing transmission facilities.

Regardless of load density, however, and the limitations of the existing available system, good service must be maintained for these rural loads, with voltages held reasonably near their nominal values, and with no more than a reasonable variation. The natural growth and development of a rural line is a piecemeal growth, one extension after another being added onto an existing line until the line is many miles in length, with corresponding increases in voltage loss and related troubles unless some regulating means are provided. The voltage problem frequently arises from, or is aggravated by, the fact that the rural line is served by a step-down substation with no voltage-control apparatus to compensate for its own transformer regulation and the supplying transmission line voltage variation.

Need of a voltage-regulating device which would be low enough in cost to be economically justifiable for application in the remedying of voltage troubles on rural lines has been felt for some time. To correct for excessive voltage losses in the line or to compensate for an excessive variation on the transmission system and through the step-down transformer has, in the past, too frequently involved a choice between remedial equipment such as induction regulators, the cost of which could not be justified by the revenue involved, or the taking of no corrective measures, which, of course, handicaps load development in that particular area.

A new type of voltage regulator recently brought out answers the need for a simple and low cost regulator applicable to rural lines and other places where improvement of voltage regulation at a low cost is needed. The first installation of this new type voltage regulator was made in September, 1932, on the Roanoke-Fincastle 6,900/12,000-"Y"-volt line of the Appalachian Electric Power Company near Roanoke, Va. The results were not only very gratifying from a functional standpoint but also from the cost angle, the total installed cost of the

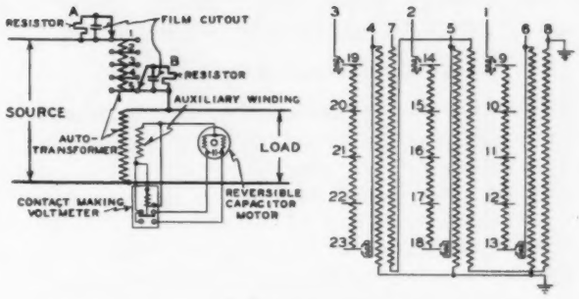
regulator being about half the estimated cost of the cheapest other remedy considered. This low cost enabled corrective measures to be taken within economically justifiable limits.

Description of step-voltage regulator

Similar to the control apparatus of an induction regulator, this new regulator employs a contact-making voltmeter, but instead of a moving coil, to vary the secondary voltage of the regulator, a multi-tapped auto-transformer with an automatic load-ratio control mechanism of a new type is used. As now developed, this new apparatus, known as an "automatic step-voltage regulator," gives a possible 10 per cent boost-and-buck range in 2½ per cent steps, four above and four below normal voltage, by changing the relative position of line and load connections on the various tap positions of the auto-transformer winding. Although developed essentially as a three-phase regulator, it can be applied to single-phase circuits. It is designed for operation on lines of 4,800 to 13,800 volts, with loads of 50-amp. line current, or less.

Completely assembled the equipment is compact and self-contained. The regulator can easily be mounted on a two-pole platform mounting, which obviates the necessity of purchasing land for a ground installation. Installation details are simple, the only external connections being to connect the incoming line leads and outgoing load leads to their respective bushing terminals.

The component parts of the regulator are contained in separate compartments and are easily accessible. The auto-transformer and the load ratio-control mechanism are under the same cover, but in separate compartments, with cable connections between the two compartments made through bushings below the oil level. Handholes are provided so that the mechanism can be visually inspected without removing it from the tank. For maintenance work, the entire mechanism can be lifted out as a unit. The voltage control panel and equipment are mounted on the side of the main tank and are housed in a waterproof casing with a two-sided swinging door.



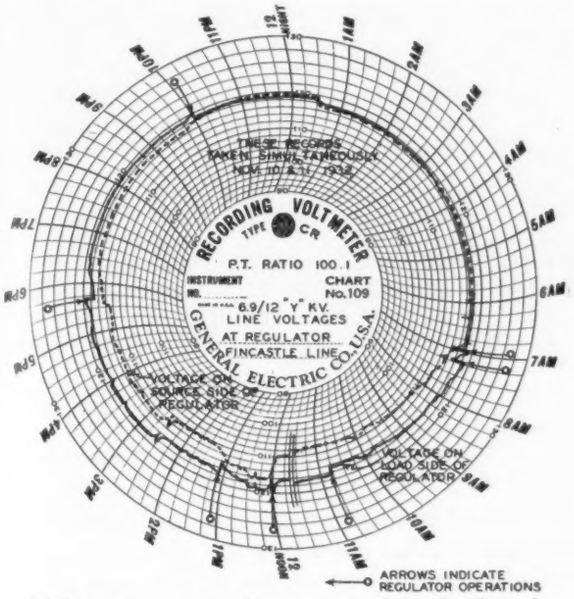
CONNECTIONS				
LINES ON 1, 2 AND 3				
VOLTS	AMP	RATIO ADJUSTER CONNECTIONS *		
13750	50	1 TO 9, 6 TO 13	2 TO 14, 5 TO 18	3 TO 19, 4 TO 23
13438	50	1 TO 9, 6 TO 12	2 TO 14, 5 TO 17	3 TO 19, 4 TO 22
13125	50	1 TO 10, 6 TO 12	2 TO 15, 5 TO 17	3 TO 20, 4 TO 22
12813	50	1 TO 10, 6 TO 11	2 TO 15, 5 TO 16	3 TO 20, 4 TO 21
12500	50	1 TO 11, 6 TO 11	2 TO 16, 5 TO 16	3 TO 21, 4 TO 21
12188	50	1 TO 11, 6 TO 10	2 TO 16, 5 TO 15	3 TO 21, 4 TO 20
11875	50	1 TO 12, 6 TO 10	2 TO 17, 5 TO 15	3 TO 22, 4 TO 20
11563	50	1 TO 12, 6 TO 9	2 TO 17, 5 TO 14	3 TO 22, 4 TO 19
11250	50	1 TO 13, 6 TO 9	2 TO 18, 5 TO 14	3 TO 23, 4 TO 19

* CONNECTIONS MADE AUTOMATICALLY BY LOAD RATIO CONTROL MECHANISM.

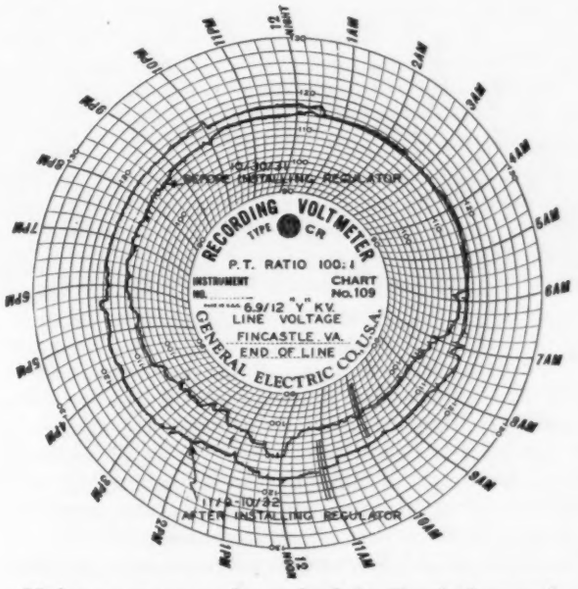
Schematic diagram, developed winding and load-ratio adjuster connection for step-regulator

The voltage-control equipment is similar to that used for induction regulators. The contact-making voltmeter, in conjunction with a relay switch, controls the operating motor. The operating motor, located in the top of the load-ratio compartment, winds a sturdy helical spring for each operation. About ten seconds is required to wind the spring completely, this feature furnishing the necessary time delay to prevent operation due to voltage variations of short durations. The regulator can also be operated manually and is adaptable to line-drop compensation.

The contact-making voltmeter is energized from an auxiliary winding which acts as a potential transformer, measuring the voltage on the load side of the regulator. This auxiliary winding is single phase, but is wound with a section of the winding on each of the three legs of the


THESE RECORDS TAKEN SIMULTANEOUSLY NOV. 10 & 11, 1932
RECORDING VOLTMETER
TYPE CR
P.T. RATIO 100:1
INSTRUMENT NO.
CHART No.109
6.9/12 "Y" KV. LINE VOLTAGES AT REGULATOR FINCASTLE LINE
GENERAL ELECTRIC CO. U.S.A.
VOLTAGE ON SOURCE SIDE OF REGULATOR
VOLTAGE ON LOAD SIDE OF REGULATOR
ARROWS INDICATE REGULATOR OPERATIONS

Voltage curves on the source and load sides of the step-regulator



Voltage curves at the end of the line before and after installing the step-regulator

auto-transformer. This same winding furnishes the energy for operating the reversible, capacitor type, motor.

Load-ratio control mechanism

The various tap positions on the auto-transformer are shown on the developed winding in the illustration. The winding is the same for either a grounded or ungrounded system, the only difference being that on a grounded neutral system the neutral of the common winding must be solidly grounded, whereas on an ungrounded, or isolated, system the neutral point of the common winding must be grounded through an internally mounted resistor.

The load-ratio control mechanism consists of two three-phase, twin-ratio adjusters, each with a heavy helical spring. This spring, when wound and released, snaps the adjuster to the next tap position at high speed. The two adjusters operate alternately, nine voltage steps being obtained from combinations of the five transformer taps. In changing tap positions a set of auxiliary contacts on each phase bridges the gap between tap positions, the momentary circulating current being limited by a resistor. All contacts are self-aligning and are under pressure. The power required to operate the mechanism is small, the motor being only 1/100 hp. The operating springs are wound for each operation, and when released are completely unwound in throwing the tap-changing mechanisms. They are, of course, reversible.

If, for any reason, the contacts of one of the ratio adjusters should stop in an intermediate operating position, the load current passing through the bridging resistor will burn the resistor out and the film cutout will break down. The motor circuit is operative only when both ratio adjusters are in a correct operating position. With this scheme of protection the regulator will become inoperative, but will not interrupt service on the line. By-pass arresters are mounted across the outside bushings to protect the transformer windings from overvoltage. These arresters, however, do not protect the regulator against excess voltage from line to ground.

First installation made near Roanoke

The problem presented on the Roanoke-Fincastle line was a voltage problem typical of that existing on many other rural or semi-rural lines. The problem, in the main, was to iron out a wide voltage variation and to raise the general voltage level. The step-regulator installed on this line was a 50-amp., 1,080-kva., three-phase unit, for 6,900/12,000-"Y"-volt operation with four 2½ per cent voltage tap positions above and below the nominal 12,500-volt position. This permits the source to range from 11,250 to 13,750 volts, the regulator maintaining approximately the nominal 12,500 volts on the load side.

The Fincastle line extends north from Roanoke a distance of about 20 miles. The line now operates at 6,900/12,000 "Y" volts, with solidly grounded neutral, and serves a load of about 1,500 kva. peak demand. About half of this load is comprised of industrial loads located near Roanoke and within the first 3 miles of the line. Beyond the industrial loads two small semi-urban substations are served, the line extending far out beyond these into rural territory, serving rural residents along the route and several small rural communities.

The loads on this line developed rapidly and within the past year or so exceeded the good service capacity of the original line. This resulted in a higher voltage drop in the line than desirable, especially in the first section serving the industrial loads. Aggravating the voltage trouble to an extent even greater than the voltage loss in the line itself was the wide daily voltage variation at the source of the Fincastle line. The combination of these two resulted in a voltage variation of more than 14 per cent in the village of Fincastle at the end of the line, approximately 20 miles from the substation. A study of the situation disclosed that the voltage rendered the industrial loads was satisfactory for industrial purposes, and that the voltage drop in the line itself beyond the point where the industrial load was served was not excessive. The solution of the problem then resolved itself into ironing out the wide variation that existed and doing this at a point where the greatest improvement in service to the lighting loads would be brought about, provided it could be accomplished at a reasonable cost. An installation of induction regulators was considered for this job, but was found to be too high in cost. To bridge the gap between no regulation and the higher cost of an induction regulator installation the step-regulator was developed. This furnished an economical solution to this problem.

First installation makes big improvement in voltage

Illustrations show the voltage charts which were taken simultaneously on the source (line) and load sides of the regulator installation. These two curves not only show the improvement brought about in voltage variation and general level, but also indicate the regulator operations. Seven operations occurred during this 24-hour period. Although the regulator operates in steps of 2.5 per cent, the contact-making voltmeter was adjusted so as to reduce the over-all variation to about 4 per cent. This variation is probably larger than would be desired for some other installations, and for such cases the thing to do would be to employ a regulator with voltage steps of 1.5 or 2 per cent, which can be done, provided the number of steps is not changed. This would lower the over-all variation to near 3 per cent, but would lower the maximum range of the regulator. This would probably mean more frequent operation of the tap changer, but this should not introduce any difficulties inasmuch as this type of regulator is fundamentally rugged and on test was carried through 100,000 operations without trouble developing.

The improvement in voltage conditions at the end of the line is shown in the accompanying illustrations. From the two voltage curves showing voltages at Fincastle before and after installing the regulator, it will be seen that the voltage level was greatly improved and that the variation was reduced from an original value of more than 14 per cent to below 5 per cent. In this connection it might be pointed out that the voltage on this line has been held to around 11,750 volts, inasmuch as it was just recently changed from a three-wire, three-phase, 11,500-volt circuit to a four-wire, three-phase, nominally rated 6,900/12,000-"Y"-volt circuit. Many of the original 11.5-kv. transformers are still in service, the 115-volt secondary voltage being maintained on the more recent 6,900-volt installations by using the standard reduced voltage taps on 6,900-volt transformers.

Installed cost half of other remedial methods

The total installed cost of the Fincastle line regulator, including regulator, line lightning arresters, complete mounting and subsequent adjustments, was approximately $3,250. As now operated, the regulator is in a

boost position most of the time, but provisions have been made for the installing of booster transformers ahead of the step-regulator in case the source voltage becomes lower before the system changes, already planned, are carried out which will improve this situation at the origin of the Fincastle line.

Other schemes of solving the voltage trouble on the Fincastle line were considered, but all would have involved a much larger expenditure. Induction voltage regulators would have accomplished the same result; in fact, would have given an even better regulation on the load side of the regulator, but the first costs would have been considerably higher. The maintenance work required on the step-regulator is also expected to be less than for induction regulators. The lowest cost plan using induction regulators would have been to use a three-phase, 2,300-volt induction regulator with the necessary three-phase exciting and series transformers. Estimating such an installation on the same basis as was actually used for setting up the installed cost of the step-regulator, the complete installed cost would have been about $6,000. If three single-phase, 6,900-volt regulators had been used the complete installed cost would have been about $7,800. The losses are also considerably less for the step-regulator than for a corresponding installation of induction regulators. For the step-regulator, as used on the Fincastle line, the core losses are 687 watts and the copper losses 1,954 watts with the regulator in the maximum boost position and carrying full load. A three-phase, 1,080-kva. induction regulator would have a core loss of 1,400 watts and a copper loss of 2,500 watts.

In analyzing the economic set-up of this proposed solution to a voltage problem it is obvious that not all of the expenditure has to be charged against improvement of customers' service and relations. In this particular installation, for example, such an improvement in the line voltage at times of peak lighting loads will not only mean better service but will also result in an increase in revenue. It is estimated that the annual revenue derived from the Fincastle line will be increased by about $1,000.

Although each line is necessarily an individual problem, and the facts and conditions may be quite different than those which were encountered in this particular case, there are undoubtedly many places, and particularly on rural or semi-rural distribution systems, where a low-cost voltage regulator can be economically justified. The step-regulator will not entirely replace the induction regulator, for the step-regulator does not hold the voltage down to the narrow variation that induction regulators do. The step-regulator, however, admirably answers the need for a low-cost voltage regulator for rural lines, or on any line or circuits where some regulation is essential but where the 100 per cent solution possible by the induction regulator or synchronous condenser is, because of economic limitations, out of the question.

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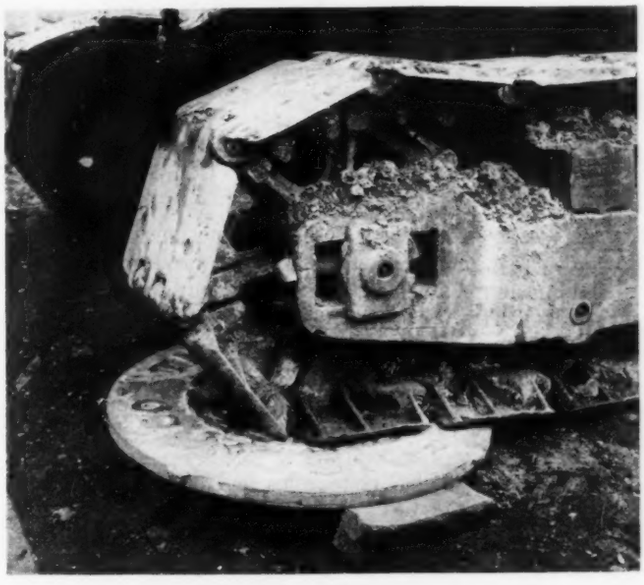
Solved—the Manhole Cover Problem

No more broken or bent manhole covers to crack automobile springs or be the cause of even more serious accidents. This apparently is the well-justified promise of a new kind of cover that is now being tried out by the Detroit Edison Company. The covers used by the company were formerly made of ordinary gray iron in a simple but heavy design. These cast-iron covers, cheap enough in first cost, were expensive from the standpoint of breakage in the street, especially in the winter months.

But the new kind of cover will neither break nor bend under abuse that the old ones could never stand. Imagine a cover, supported on the ends of a couple of blocks as shown in the photograph, tilting down, returning to horizontal and tilting again, as the treads of a heavy tractor crane pass over it—not once or twice or five or six times, but until the driver is finally convinced that he can't break the darn thing. And when the cover is measured, only about $\frac{1}{16}$-in. maximum deflection is discovered.

This new cover is made of electric gray iron, produced from a Detroit electric furnace, installed in the Atlas Foundry, Detroit. An improved design of ribbing, made possible by the better physical properties of electric iron, makes the new cover weigh only about 172 lb., as against 212 lb. for the old cast-iron cover. Because of this saving in weight and its good machining properties, it bids fair to be less expensive in first cost. Costs of production, however, are not yet well established. Even if they turn out to be somewhat higher, the difference will be well spent, for the greatly improved quality of the product will eliminate the large annual cost of replacing broken covers.



Taking punishment

Loads of 15 tons and more were applied to this rough casting of an electric steel manhole cover as the tractor crane trundled back and forth over it.

It is not to be forgotten that each cover cast will represent an energy consumption of about 60 kw.-hr., and if the short anneal is given in an electric annealing furnace this would add another 10 kw.-hr. per cover The electric furnace in which these covers are made is the rocking, indirect arc type, manufactured by the Detroit Electric Furnace Company.

Cost of Construction "Sub" $4.58 per Kva.

From the itemized construction cost sheets of a New England utility power installation job are taken the following data covering a 1,500-kva. temporary substation which served the enterprise. Energy was supplied at 33 kv. and stepped down to 2,400 volts.

Major Material:		Per Kva.
Three 500-kva. transformers	$2,873	
One oxide film lightning arrester	956	
One 37-kv., gang-operated air-break switch, 300 amp.	362	
Three 35-kv., 300-amp., single-pole disconnects	98	
Other disconnecting switches and cut-outs	291	
36 insulators and hardware	103	
Two tripping reactors	22	
Four trip coils	18	
Two type I-A, 201 relays	48	
Two 200-amp. current transformers	41	
Two 2,200-volt potential transformers	55	
Four 40-ft. creosoted poles	80	
Lumber, 2,635 ft.b.m.	66	
Corrugated iron roofing	29	
One 100-volt, three-phase watt-hour meter	24	
Small tools	25	
Freight on material	162	
Miscellaneous items	424	
Total material	$5,677	$3.78
Labor	1,210	0.80
Total cost	$6,887	$4.58

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READERS' FORUM

Inflation and the Public Utilities

To the Editor of the ELECTRICAL WORLD:

Recollection of the difficult period of rapidly rising commodity prices in the post-war inflation, during which many of what are now the strongest and most powerfully intrenched public utility companies found themselves confronted with the possibility of receivership, has occasioned considerable discussion of the precise effects which a period of general economic inflation at present might have on this important branch of industry. Careful analysis of the salient factors then and now indicates that even should the United States experience a rapid rise in commodity prices as a result of inflationary policies by the administration, conditions confronting the public utilities at present cannot accurately be compared with those which prevailed in 1919 and 1920. The only major similarity would be a rapidly rising level of commodity prices. In virtually every other respect the differences between that period and the possible era which may lie ahead are strikingly at variance.

The electric and gas companies in 1919 and 1920 were confronted with depleted personnel as a result of war, with plant capacities which were scarcely adequate to handle the continued rapid growth in demand for service, with costs of inferior quality coal at exorbitant levels, and the necessity of purchasing large amounts of raw materials necessary in the construction of new and enlarged facilities. Thus, the costs of doing business were being increased in various ways. At the present time, on the other hand, the only major increases in expense which would appear probable are higher prices for coal and, perhaps, certain minor cost items. At the same time, almost every major operating company in the United States has sufficient capacity installed to generate and distribute a much greater output than currently is demanded. The necessity for additional construction, therefore, is largely absent and higher prices for such construction commodities as steel, lead and copper would have no great effect for the present. A rising price level now would probably mean a higher cost for coal, which is an important item of operating expense. In the case of the leading manufactured gas companies in New York City, namely, Consolidated Gas Company of New York and Brooklyn Union Gas Company, the gross cost of coal is equivalent to approximately 15 per cent of operating expenses or 8½ per cent of operating revenues. These companies, it should be noted, produce both coal gas and water gas and are not as heavily dependent upon coal as those manufacturing solely coal gas.

The American Gas & Electric system affords an excellent example of a utility producing electricity by steam almost exclusively, as contrasted to water power. In this system the cost of coal amounts to approximately 26 per cent of operating costs and maintenance or, stated differently, to about 8 per cent of gross operating revenues. Careful analysis of other major items of expenditure, such as labor, taxes, depreciation, interest, amortization and preferred dividends, indicates that these disbursements would be affected but slightly. *The direct effects of an inflationary program, provided it is held within reasonable bounds, should, therefore, not be particularly severe in expanding public utility operating costs.*

In various direct and indirect ways, furthermore, the public utility companies stand to benefit quite considerably from a mild inflationary program. *Undoubtedly, the demand for power from industrial, commercial and domestic users would be stimulated by a general increase in trade activity. Of considerable significance, also, would be the decreased agitation for lowered electric and gas rates.* During the course of the past three years the major costs of living, such as clothing, food and rent, have declined steadily and rapidly. The fact that electric and gas rates have declined at a much slower pace has brought this item in the family budget into considerable prominence and has been seized upon by the radical press and politically minded legislators as a golden opportunity to appeal to popular emotion and capture the public eye.

Should the downward trends of 1930-1932 be reversed and the costs of food, clothing and rent rise, the relative inflexibility of gas and electric rates would stand out as an advantage to the sellers of these services. Under such circumstances it would be extremely difficult, if not impossible, to stimulate much popular enthusiasm against public service corporations. It is clear, therefore, that a mild inflation would be of considerable indirect benefit and of but slight direct detriment. Should prices rise to such an extent as to force public utilities to endeavor to obtain higher rates for their services, the situation would not be so favorable, for although rates can be brought down rapidly, an increase is normally a matter of years and, in some cases, almost out of the question.

Under these circumstances, and predicated on the belief that no violent inflationary period is in prospect, continued retention of sound public utility securities is wholly advisable. The stronger common stocks, such as those of American Gas & Electric, Columbia Gas & Electric, Consolidated Gas Company of New York and United Gas Improvement, to mention only a few, are attractive on the basis of current earning power and should perform in a wholly satisfactory manner in the general market.

L. SANFORD REIS,
Chas. D. Barney & Company, Public Utility Analyst.

BOOK REVIEWS

High-Frequency Measurements

By August Hund. Published by the McGraw-Hill Book Company, 330 West 42d Street, New York. 491 pages, illustrated. Price, $5.

Comprehensive in its assembly of the multiplicity of means devised for high-frequency measurements by a horde of workers, this book constitutes both a handbook and text on the subject. Particular emphasis is placed on showing limitations in scope as well as virtues of simplicity and refinement of the various techniques.

After establishing the differences in circuit behavior of low and high frequencies the sources of high-frequency supply are discussed, including the cathode-ray tube. Measurement of minute magnitudes of tube and ionization currents is followed by electrometers, spark gaps, corona and tube voltmeters, in alternating and rectified form. The difficulties in precise determination of f are analyzed, especially the resort to harmonic multiplication and division, Lissajou figures and piezo oscillators. Procedures for determining R, L and C and their mutual values and for wattage and decrement measurements are well covered. Likewise modulation, propagation, aerials and lines are treated adequately. Diagrams are profuse in number, but, unfortunately, several are reduced almost to illegibility in the reproduction.

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Artificial Earthing for Electrical Installations

By T. G. Gilbert. Published by Ernest Benn, Ltd., Bouverie House, 154, Fleet Street, London, E.C. 4, England. 173 pages, illustrated. Price 9 shillings, net.

Mr. Gilbert pleads urgently that Britain adopt the German (Rheinish-Westfaelisches Power Company the principal exponent) scheme in which fuses are replaced by a multi-pole switch tripped by a relay which is actuated by ground fault currents in excess of from 15 to 35 milliamperes. In building up his case he shows comprehensively what he believes to be the fallacies in relying upon solid (?) grounding of the neutral. His preferred scheme uses an artificial ground.

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Principles of Radio Communication

By J. H. Morecroft. Published by John Wiley & Sons, Inc., 60 Broadway, Brooklyn, N. Y. 1084 pages, illustrated. Price, $7.50.

Five more years of evolution of the radio art has made necessary a third edition of "Morecroft," to that art what "Ganot" for so long was to physics. Keeping abreast of the unfolding of new principles upon which the new practices are being built, the new edition gives added space to rectifiers, treatment of shielding has been much amplified, the electrolytic condenser is introduced, crystal oscillation discussed more comprehensively and the short wave dealt with at greater length. Atmospheric and earth manifestations are analyzed in accordance with the significance of directed radiation and beacons for compass service.

In no sense a treatise on practice, the book does, however, inject enough of current practice to reveal the significance of the principles which are its main objective. It thus has high usefulness to the general electrical engineer who is facing the progressive intrusion of thermionic tubes, oscillating circuits, rectifiers, condensers and other paraphernalia from the wireless field into his own grosser field. Useful working data are sprinkled throughout the text and characteristic curves of circuits and devices constitute a large portion of the more than 1,000 illustrations in the book.

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Lightning Protection of Distribution Systems and Transformer

By C. S. Sprague and C. F. Harding. Research Bulletin No. 42. Published by Engineering Experiment Station, Purdue University, Lafayette, Ind. 89 pages, illustrated. Price 50 cents.

Joint investigation by the experiment station and Utilities Research Commission on protection of transformers, especially from the secondary side, is reported here in full detail. Field and laboratory set-ups simulating distribution circuit, transformer, service with and without load, grounds and arresters were studied intensively by imposing artificial surges upon them. That a grounded secondary neutral affords some shielding, low ground resistances do not necessarily reduce neutral potentials and interconnection of primary arrester grounds with secondary neutral effects a reduced voltage induction are some of the conclusions. There is comment on the efficacy of arresters, of self-protecting transformers and duplicated ground wires.

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The Technical Man Sells His Services

By Edward Hurst. Published by McGraw-Hill Book Company, 330 W. 42d Street, New York. 239 pages. Price, $2.

Nineteen out of twenty unemployed technical men say there are no jobs because they "have looked for jobs and found none." The twentieth man found an opening because he sought unsolved technical defects in industry and sold his services on a "payment-out-of-savings" plan, confident he could correct specifically wasteful practices. In this book the author takes you to listen to the interviews of ten graduates of diversified technical courses when they spar with prospective employers. The strategy of the applicant and the gradual yielding of the employer are detailed in successive chapters.

The sales technique of the applicant often involves volunteering to undertake a critical study in the employer's plant; the method of making several such studies and the use of the results in landing the job are carried out in illuminating detail.

Some will say the author credits engineering education with far more proficiency than it attains. Others will say that he credits the young sprout with too much erudition and insouciance about his potentialities. By just the amount that either of these criticisms is well founded the book is to be rated of immediate value to the more mature unemployed technical men, of whom there are far more than profitless competition justifies. Also 90 or 95 per cent of those who could profitably read the book will conclude they never before conceived how lacking they are in the capacity to sell their stock in trade, a technical training "all dressed up and no place to go."

Men of the Industry

E. S. THOMPSON, treasurer of the American Water Works & Electric Company, Inc., since 1926, has been elected vice-president and treasurer of the company.

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JAMES A. REED, formerly Senator, of Kansas City, Mo., has been named vice-president and general counsel of the Iowa Electric Light & Power Company at its recent annual meeting. Mr. Reed, who was also elected a member of the board of directors, is succeeding his brother, the late John A. Reed.

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ROBERT D. BLACK has been appointed sales manager of the Black & Decker Manufacturing Company. Mr. Black has a background of shop and practical sales experience, as well as broad experience as a sales executive, all combining to give him a comprehensive picture of merchandising problems from a national and international viewpoint.

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HOWARD A. STANLEY, formerly vice-president and general manager of the Fall River (Mass.) Electric Light Company, and more recently of the electrical engineering departments of the Narragansett Electric Company, Providence, R. I., and the New England Power Engineering & Service Corporation, Boston, has joined the organization of the Berkshire Fine Spinning Associates, with headquarters at Fall River, with the title of plant engineer. Mr. Stanley is one of the best known operating men in the northeastern utility field.

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HOWARD H. ADAMS, who has been assistant to the president of the Northern Indiana Public Service Company, has been elected vice-president and general manager of that utility. DEAN H. MITCHELL, who has been comptroller, was elected vice-president and comptroller. Both Mr. Adams and Mr. Mitchell have been elected members of the board of directors.

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D. W. ROPER, superintendent of the street department of the Commonwealth Edison Company, has been transferred to the engineering department and appointed an assistant electrical engineer. In this capacity he will continue to direct the cable research and related work formerly carried on by the technical division, street department. The personnel and activities of the technical division were also transferred to the engineering department, where it will be designated the research division. HERMAN HALPERIN, formerly head engineer, technical division, will have the title of cable research engineer. A. P. THOMS, formerly first assistant superintendent of the street department, was appointed superintendent to fill the vacancy created by the transfer of Mr. Roper. Mr. Roper became identified with the old Chicago Edison Company in 1903, and has been continuously associated with that organization and its successor, the Commonwealth Edison Company, up to the present time. For many years he has been actively connected with the National Electric Light Association, now the Edison Electric Institute, and with the American Institute of Electrical Engineers.

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PETER J. MULVEY, who first began testing electric machinery at the Schenectady Works of the General Electric Company 42 years ago, retired March 31. Three years after arriving in this country from Scotland he went to work in the Edison plant at Schenectady in 1891, for many years having charge of railway motor test, then small motors and generators, and, since 1931, induction motors.

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T. W. OSGOOD, formerly assistant superintendent of safety of the California Industrial Accident Commission, has been appointed safety engineer on the Colorado River aqueduct project of the Metropolitan Water District of Southern California.

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T. K. MIAL, regional vice-president of the Johns-Manville Sales Corporation, has recently been appointed an executive vice-president of that company. Mr. Mial will be general sales manager of the power products department and in that position will direct the sales of the company's products in industrial fields, including insulation, packings, power specialties, electrical products, pipe line protection.

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GEORGE C. WARD, president of the Southern California Edison Company, Ltd., was honored by the Los Angeles Engineers' Club May 2, when a certificate of honorary life membership was presented to him in recognition of his many accomplishments in the field of engineering. The presentation was made by Charles S. Howe, president of the club, in Mr. Ward's office in the Edison Building.

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A. G. DECLERCQ, construction engineer of the Commonwealth Edison Company, has been appointed to the newly created position of general service manager. The service and repair, meter and lamp renewal departments and the service bureau have been transferred to his supervision. Mr. deClercq has been identified with the Chicago utility continuously since 1899 with the exception of a short leave of absence spent at the Michigan Agricultural College at Lansing. After holding various positions he was appointed construction superintendent in 1918.

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EDWARD S. MANSFIELD, head of the educational bureau of the Edison Electric Illuminating Company of Boston, has retired from active service after completing almost 36 years of service with that utility. Mr. Mansfield directed the company educational activities for many years prior to 1926, when the educational bureau was organized and he was appointed its head. He was an untiring committeeman and willingly gave of his energy and time to the work of the National Electric Light Association and the Electric Vehicle Association, serving as president of the latter at one time.

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R. H. WOODS, JR., has been elected vice-president of the Southern Public Utilities Company, Charlotte, N. C., to succeed the late Roy L. Peterman. For the past thirteen years Mr. Woods has been assistant to the president in charge of the company's properties in the Winston-Salem district. A native of Virginia and a graduate of the University of Virginia, he received his technical education at the Massachusetts Institute of Technology. He was connected with utilities at Rochester and Poughkeepsie, N. Y., for a period of three years, before affiliating himself with the Duke interests in Charlotte in 1915.

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OBITUARY

B. M. MADDOX of Visalia, Calif., manager of the San Joaquin Valley division of the Southern California Edison Company, Ltd., and a pioneer electric utility executive in central California, died suddenly, May 9, at Los Angeles. He was 74 years of age. In 1889-1900 Mr. Maddox, in association with A. G. Wishon and the late John Hays Hammond, organized the Mt. Whitney Power Company, a pioneer in the utilization of the water resources of the Sierra Nevada mountains of central California for power purposes. In 1920 the property, then known as the Mt. Whitney Power & Electric Company, was absorbed by the Southern California Edison Company and became a part of the Edison system. Mr. Maddox became resident manager at Visalia and more recently was named resident division manager of the company's entire San Joaquin Valley territory.